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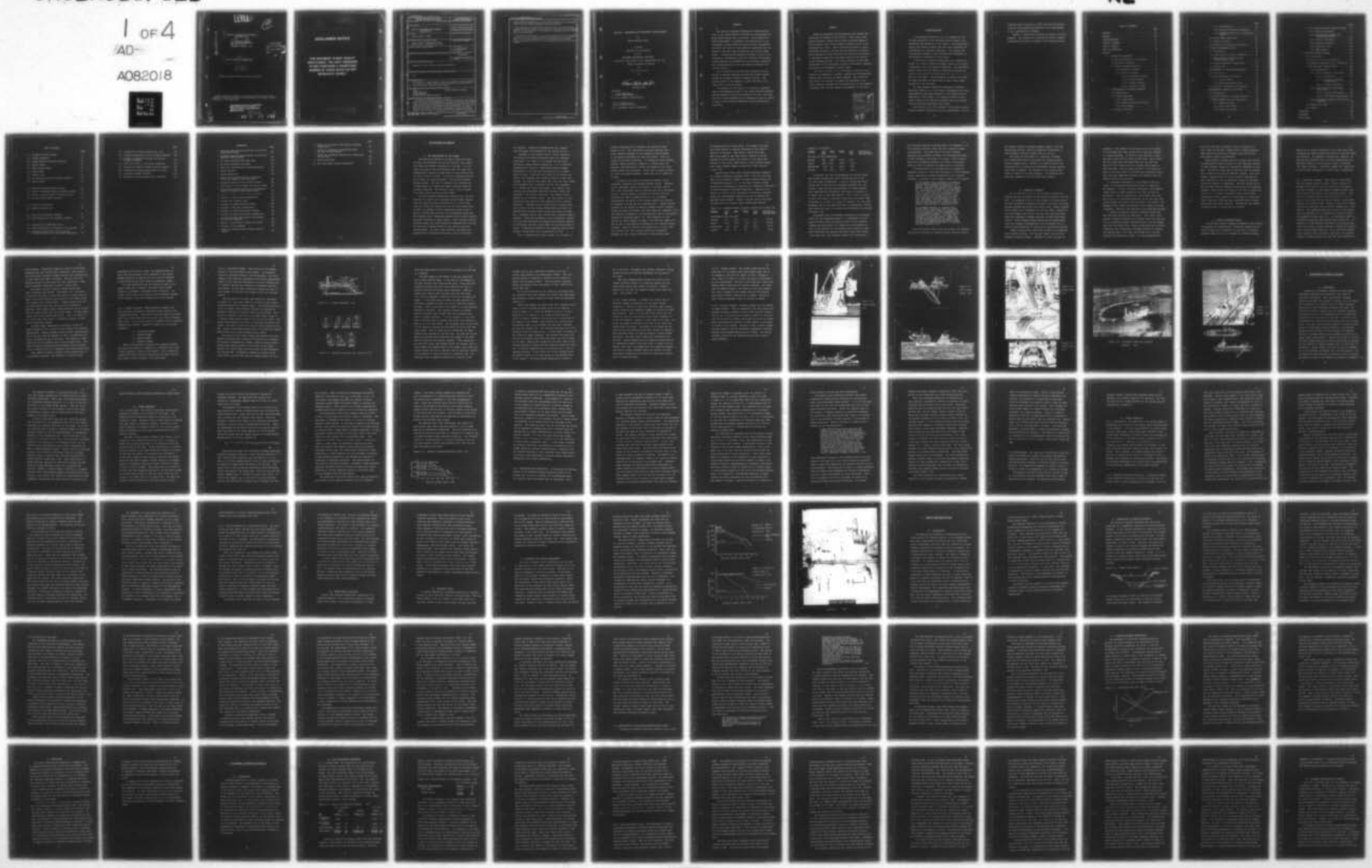

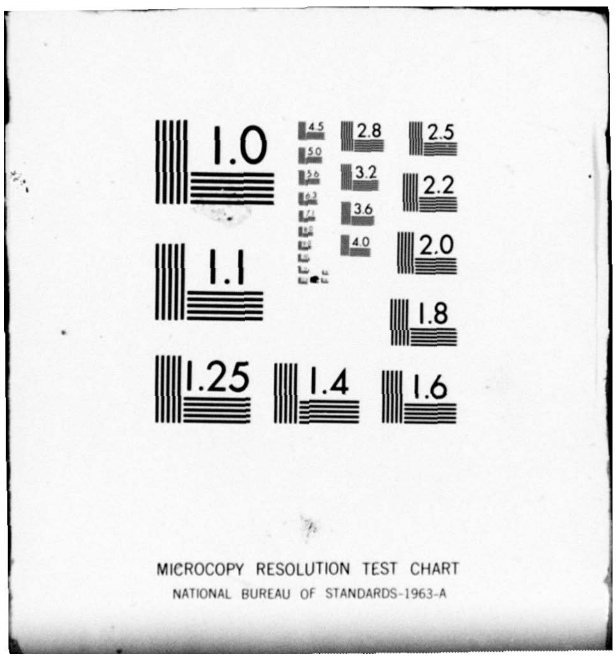
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(6) DREDGING: ENGINEERING AND MANAGEMENT CONSIDERATIONS

(10) Captain Thomas Stephen Nowak
HQDA, MILPERCEN (DAPC-OPP-E)
200 Stovall Street
Alexandria, Virginia 22332

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The status of dredging technology as currently practiced in the United States is defined by investigating the major forces acting upon the process. Areas analyzed include advancements in equipment, new applications of the technology, factors affecting dredging project management, the extent and effect of environmental regulations and the status of both the Corps of Engineers and private dredge fleets. Information was generated through a review of the literature, correspondance with both American and European

dredge suppliers and manufacturers and personal interviews with representatives of both the Federal government and private industry.

New information is provided which describes recent trends in national dredging activity and current funding levels for federally financed dredgin projects. The current status of the program to reduce the size of the Corps fleet is also presented.

The purpose of this thesis is to provide a composite view of the dredging process to the widest possible audience. Through analysis of the current state of the art, the intention is to focus attention on the dredging process as a whole so that it may be better understood and more efficiently utilized.

DREDGING: ENGINEERING AND MANAGEMENT CONSIDERATIONS

by

Thomas Stephen Nowak

A Thesis

Submitted to the Faculty

of the

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Thomas Stephen Nowak

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APPROVED:

A.F. Chalabi

Dr. A.F. Chalabi, Major Advisor

K. Keshavan

Dr. K. Keshavan, Head of Department

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PREFACE

There are extremely few publications which explain the technology of dredging in its totality. While there exist numerous research reports and articles describing segments of the process, they do not provide a composite view of the technology as a whole. Those individuals wishing to understand what dredging is and its current status as a construction technique are thus faced with the difficult requirement of compiling through much individual effort a true picture of the dredging process. This thesis attempts to fill this significant void by analyzing the major forces which influence the practice of dredging in America today.

The current status of the technology is defined by analyzing the legislative, economic, engineering and managerial factors which continue to affect dredging. The results of this thesis are intended to augment the knowledge of the widest possible audience while providing those in the industry an insight into the most current developments in the field.

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I am extremely grateful to Dr. A.F. Chalabi for the valuable assistance he has provided in both aiding in the formulation and execution of this report. His enthusiastic support and sincere interest have made this personally and professionally a rewarding experience. The constant and irreplaceable guidance he has provided were fundamental to the successful completion of this thesis.

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Mr. John Roberge, Hydraulics Laboratory, Waterways Experiment Station, U.S. Army Corps of Engineers, also aided immeasurably in providing guidance in the formulation and completion of this thesis. His frequent efforts in this regard helped in the difficult research phase and provided a motivating force throughout the project.

The efforts of Mr. Alf Sorenson, Vice President, Sales, Ellicott Machine Corporation, are also appreciated. The in-

formation gained through his office and from the personal interview were significant additions to my understanding of the complexities of dredging.

Finally, I would like to express my thanks to my wife Margaret. Her patience and consistently positive support strengthened my efforts throughout this demanding period.

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1.1 THE SIGNIFICANCE OF THE PROCESS

The history of mankind is strongly linked with water not only for sustenance but also for purposes that reflect his social and economic progress over the ages. It is no chance occurrence that civilizations great and small have systematically sprung up along bodies of water whether they be lakes, rivers or oceans. As societal standards evolved, use of water as something beyond a life giving substance became possible. The need to transport raw materials and finished goods over longer and longer distances became an economic necessity. The ability to move people and goods over water became crucial as never before.

As local economies became more sophisticated, the size and draft of vessels both increased so that larger cargoes could be moved with less difficulty and at a lower total cost, but rivers and harbors were not all sufficiently deep to allow the passage of these increasingly large vessels. Shoals, shifting sand bars and rock outcroppings along what were thought to be a thoroughly passable water network created immovable obstacles to these vessels. Great journeys could be prevented merely by a short stretch of submerged sand that may not have been a problem before or that may not even have existed before. To remove these barriers, techniques and equipment were developed and evolved to what is now known

as dredging. Although the equipment may have changed over the years, the necessity for the process has not.

Dredging, in its simplest terms, "can be defined as the science of excavating materials which are sumberged under water." (1) While to the layman this may seem a relatively straightforward proposition, it is nonetheless compounded by a series of complicating factors primary among which is the fact that the material to be removed cannot be seen. This basic fact leads to the obvious conclusion that locating these deposits becomes a great task. Further, the location once fixed, can, and often does, change both seasonally and in response to short term phenomena (i.e. storms) and longer term trends. For example, land clearing and development operations increase erosion and subsequent river bottom deposition. The problem becomes largely one of invisible motion. Not many sectors of civil engineering must deal with such transient and ill defined situations. Roadbeds can be clearly fixed, building structures tend not to move during construction and project inspectors can relatively easily insure that goals are being met. Dredging, however, must contend with a greater range of problems. Rivers are certainly no more transparent, weather still severely influences the process and equipment advances are infrequent and have little effect on the endless need to dredge. Dredging has remained a very empirical process with advances coming slowly over a long period of time.

But is dredging really that crucial? Is it worthy of

greater investigation or research? The answer for many people is "no." Few individuals including engineers have even a passing knowledge of the dredging problem although it has greater importance now than ever before. This is a result of two major conditions. The capability which dredging permits, namely waterborne commerce, is largely taken for granted, under-estimated in extent and assumed to be a relatively problem free procedure. Rarely does a barge or passenger liner run aground anymore. Simply put, out of sight out of mind.

In reality, the extent of waterborne commerce is an essential, formidable and growing national system. "Commerce on U.S. waterways reached an estimated 1.9 billion tons in 1977, some 3.6% higher than the previous year and a new annual record. Foreign commerce increased by 6.9% over 1976 and accounted for 48% of tonnage carried on U.S. waterways. Approximately two-thirds of the foreign commerce was imports, an increase of 11.3% over the preceding year....Inland commerce accounts for two-thirds of domestic tonnage, coastal transportation for about one quarter, and Great Lakes the remainder." (2) This amount is estimated to be approximately "16% of the nation's tonmiles of intercity cargo." (3) This translates to 350 billion ton miles annually or about 7 ton miles per capita. (4) But the key to this method of transport is its economic attractiveness. Cargo is carried at an average cost of only 3 mils per ton mile. (5) The economic benefits of waterborne commerce are most clearly reflected at choke points along

the system such as at major ports. For example, the economy of New Orleans is greatly influenced by the level of activity at its port. "The chain of events that start when cargo lands at that port finally results in the employment of 37,000 people, $7 million in city taxes, $19 million in state taxes, $256 million in port related income, and a total economic impact on Louisiana of $1.8 billion a year." (6)

Another major factor that elevates waterborne commerce to a higher nationally strategic level is the fact that over 50% of the waterborne freight is energy related--either coal or petroleum products. (7) In this age of greater energy sensitivity, maintaining in operation an inexpensive "pipeline" is without question a national imperative. America is certainly not unusual in its dependence on waterborne transport. Europe has traditionally maximized its use of natural and man-made water networks. Figure 1 clearly depicts the great reliance placed on Europe's great inland water network.

Figure 1.1: European Traffic Analysis (current as of 1973) (8)

Country	Rail way	Road	Water	Pipe line	Billions of tons per mile
Percentage of tons per mile:					
Germany	36	28.9	25.2	9.9	108.50
France	34.8	42.4	6.5	16.3	119.60
Netherlands	5.9	26.9	56.7	10.5	31.77
Belgium	25.7	49	20	5.3	18.02

(Figure 1.1 continued)

Country	Rail way	Road	Water	Pipe line	Billions of tons per mile
Millions of tons transported:					
Germany	386	216.7	245.8	102.3	
France	258.1	1721	108.8	79.8	
Netherlands	23.6	365	254.7	48.5	
Belgium	77.9	341.5	101.7	33.5	

In America, the task of maintaining the nation's waterways through dredging has almost entirely fallen to the U.S. Army Corps of Engineers. It now is charged with maintaining over 19,000 miles of navigable waterways and 1,000 harbors. While meeting this challenge, the Corps annually moves approximately 380,000,000 cubic yards of material at an annual cost of over $150,000,000. "If it were all placed on land, this amount of material would cover the entire state of Delaware to a depth of 1 meter in 15 years." (9) The Corps estimates that in the years 1973-1984, an additional 3 billion cubic yards will have to be moved just to maintain the existing waterways. (10)

The general lack of knowledge concerning this prodigious effort and the technology behind it is compounded by a pervasive attitude within the private sector of the industry. Dredging has been stifled to a degree by the reluctance of those in the industry to both educate those outside of their close fraternity and transfer knowledge within their ranks. It has been said, "the dredging pioneers were interested in

the practicable aspects of making money, not academics." (11) This approach continues today with only a moderate degree of improvement. The great mass of society including engineers and government officials are insufficiently aware of what dredging is and where it is going. Only in recent years did the dredging industry even start to talk among itself in order to improve the common level of operation.

A turning point in the dissemination of dredging information occurred in 1967 when John Huston, a noted dredging expert, indicted the dredging community for its clannish attitude. An excerpt of his comments focuses on the problem:

> On the premise that a profession is known by its literature, dredging might well be eliminated. Its literature is almost nil. In general, those who are familiar with dredging are not inclined or motivated to write about it. *Those who do are few.* To the best knowledge of this writer the only useful, available literature that has originated in the United States over the past 10 of 20 years, other than that of manufacturers and the U.S. Government, can be credited to three or four individuals, at most. Without their efforts, the available literature of United States dredging would be practically zero.
>
> The dredging industry is, compared with similar sized industries, near the bottom of the list in time, effort, and money devoted to research, and the dissemination of the information obtained, is sorely needed.... Certainly not the least of our needs is a climate of public discussion. Rather than the existing hodgepodge of unrelated information, the dredging industry needs a broad firm base on which can be built a literature for the profession. (12)

Since the article quoted above was written, the dredging industry has responded to a greater degree than ever before.

The esoteric nature of dredging remains, however, with few publications giving a broad yet definitive explanation of what dredging is and the current state of the art.

The intent of this thesis is, therefore, to bridge this informational gap by describing the dredging process and its integral parts. Further, the current state of the technology will be defined by investigating various advancements within dredging. The intention is to provide information to benefit the widest audience. To accomplish this goal most segments of the field have been treated.

1.2 HISTORY OF DREDGING

No one knows who built the first dredge although some accounts ascribe its genesis to the ancient cultures of the Mideast. The Summerian city of Ur was founded 5,000 years ago on dry land surrounded by marshes which were, over time, converted through drainage and diking into fertile land. Similar examples can be found in the predecessor to the Suez Canal, constructed by ancient Egypt about 600 BC, and the 1,000 mile long Grand Canal from Hangchow to Peking completed by Kublai Khan about 1289 AD. These projects proved that man could substantially alter the original configuration of his environment and inspired future generations to carry on the constructive process.

Dredges as mechanical tools first surfaced in rudimentary form in Western Europe. The "Bag and Dipper" was the first commonly recognized dredge. Although its first use went un-

recorded, it was probably in use prior to the 15th century. It was nothing more than a barge with a long pole attached to a hinge mechanism. On the end of the pole was a large bag used to dip into the bottom of the river. Men on board the boat swung this large spoon down into the muck then back up to the surface where its contents were dumped on board the boat. Once the barge was full, it was pulled by ropes to the shore where its contents were unloaded by hand. This crude and cumbersome operation was repeated until the desired results were achieved.

A conceptual advancement of considerable insight resulted in allowing the moving water itself to carry away the deposits. In 1435, the Dutch introduced a new dredging vessel called the Water Harrow for use near the town of Middleburg. This was essentially a sail powered boat that had a series of blade-like projections on its hull that were pulled through the deposits by the motion of the vessel. The dragging blades caused the material on the bottom to go into suspension. They were then carried off by prevailing currents.

A further innovation occurred in Holland around 1600 when the Dutch invented the "Mud Mill." This vessel incorporated a series of buckets on an endless chain loop that dug into the deposits, carried them above water level and dumped them into the vessels hold. While the Mud Mill was initially manpowered, the introduction of horses on board to increase the digging power, later made this dredge one of the most productive achievements to date. It could supposedly pro-

duce up to 400 tons of material a day to a depth of 15 feet. With the Mud Mill, dredges were no longer dependent upon winds and currents for dredging action and led to a much greater degree of reliability.

These primitive dredges were all eclipsed once the age of steam powered vessels emerged but the underlying concepts of these original dredges are essentially unchanged to this date. The Bag and Dipper and the Mud Mill were the progenitors of what are now called mechanical dredges. Their successors' digging action is now more greatly optimized but still reflects the idea of physically moving the sediments either with buckets or clamshells. The Water Harrow led to the other main form of dredging now referred to as hydraulic dredging. Where before the action of the local currents were relied upon to transport suspended solids, their modern counterparts utilize powerful on board pumps to create artificial "currents" which can carry suspended solids through steel pipes over great distances. Nonetheless, the concept of moving solids in slurry form is the same.

1.3 CURRENT EQUIPMENT PROFILE

As previously stated, dredging advancements have followed two separate yet related paths. Mechanical dredges and hydraulic dredges both accomplish the same goal of removing submerged deposits but do so through two different methods.

Neither can be placed subordinate to the other since their usefulness and characteristics are suited to different types of situations. The hydraulic technique has, however, become the most prevalent due to its wide applicability and impressive capacity to move greater amounts of material over longer distances. Mechanical dredges will remain with us due to their usefulness in certain types of operations.

1.3.1 Mechanical Dredges. These types of vessels rely upon the digging action of either a bucket, dragline or clamshell which burrows into the material to be removed. The major strength of these types of dredges evolves from their relative precision in the excavating process. They can more precisely excavate around obstructions such as piles or rock ledges and can provide greater accuracy when specific job limits are set. Because of their basic design, they move the material without greatly changing its in situ density. This permits moving more material in less barges since the sediments are not expanded in volume as results from hydraulic dredge operations. An additional benefit of mechanical dredges has only recently been appreciated. The imposition of environmental regulations upon dredging has, among other things, placed a premium on minimizing turbidity levels during dredge operations. Since mechanical dredges remove deposits with a minimum of agitation, the resultant decreased turbidity levels has made them more attractive in

some instances. Mechanical dredges do suffer from two major drawbacks that have limited their popularity. Since they do not continuously transport dredged material their productivity is lower than other types of dredges. They are also more greatly affected by wave action and swell conditions. Their use is therefore restricted to areas of calmer water.

The dipper or bucket dredge is really nothing more than a floating power shovel. (See Figure 1.4) Its bucket is placed on the end of a long boom which is lowered into the water, filled with material and returned to the surface where it is dumped into a waiting barge. Digging depths up to 158 feet below water level have been reached in projects in Malaysia. More typical dipper dredge depths are up to 40 feet with an average bucket size of 13 cubic yards. Average hourly outputs are around 300-400 cubic yards. Since the bucket is on a rigid boom, wave action is especially serious for this type of mechanical dredge.

Dragline dredge operations are basically similar to dipper dredges but as a result of their design have different applications. Dragline dredges require greater operating area due to the fact that the dragline is cast a considerable distance out beyond the end of the boom. The dragline is then pulled back to the dredge's bow in long straight paths. This leads to greater usefulness when horizontal beds of material are to be removed such as in submerged strip mining operations.

The clamshell dredge is another floating application of a land-based excavator. The clamshell is a split bucket

suspended on the end of a cable. The digging action results from the free-fall of the clamshell to the bottom. Digging precision is high but its use is not as affected by wave action as are other types of mechanical dredges.

The last significant type of mechanical dredge is now largely found only in Europe. The chain bucket dredge (Figure 1.5) provides a continuous flow of material. The output of this type is the highest of all mechanical dredges but is limited in use due to sensitivity to wave action.

1.3.2 Hydraulic Dredges. Modern hydraulic dredges rely upon the basic principle of converting bottom deposits into a water/solid slurry. The action of on board pumps then transports this mixture away from the project site through floating steel pipes. It is in this sector of dredging that the greatest advances have occurred. Hydraulic dredges are of four main categories:

1. cutterhead dredges
2. dustpan dredges
3. hopper dredges
4. sidecast dredges

Each of them converts sediments into pumpable slurries but since each evolved in response to a different need, their outward appearance differs significantly. Their versatility coupled with their impressive productivity has made them the most widely utilized dredges in the world today.

1.3.2.1 Cutterhead Dredges. This sector of the dredging family is the most common of all dredges. Its operation and use is therefore worthy of further analysis. The first dredge of this type was originated by the French hydraulician Bazin in 1836. The exact mathematics of slurry transport was ill defined initially with advances in knowledge occurring only slowly. By the 1870s, sufficient progress was made so that dredges of this type have changed little over the past century.

The main parts of a cutter head dredge are reproduced in Figure 1.2. The cutter head is a series of steel blades or points mounted on a circular frame. The revolving cutter's job is to loosen bottom material that may be compacted or naturally difficult to excavate (clays or even rocks). The cutter is attached to the end of the ladder which swings in a vertical plane around a hinge on the bow of the dredge. The cutter head rotates at the end of a long shaft mounted on the ladder. The shaft is driven by a motor usually mounted on the bow. Typical cutter heads rotate from 5 to 40 RPM with applied power levels up to 3,000 horsepower being common.

The action of the cutter loosens the material which then travels by suction up a pipeline also attached to the ladder. The suction is produced by a diesel, steam or diesel-electric powered pump usually located in the middle of the dredge. (Figure 1.6) Small pumps are of the order 250-350 horsepower with 800-900 RPM. Intermediate dredges are usually around 4,000-7,000 hp and 500 RPM while the largest dredges of this

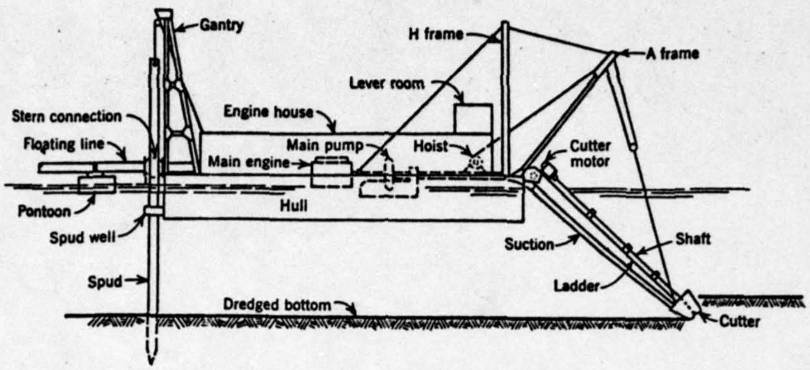


Figure 1.2: Dredge Components (13)

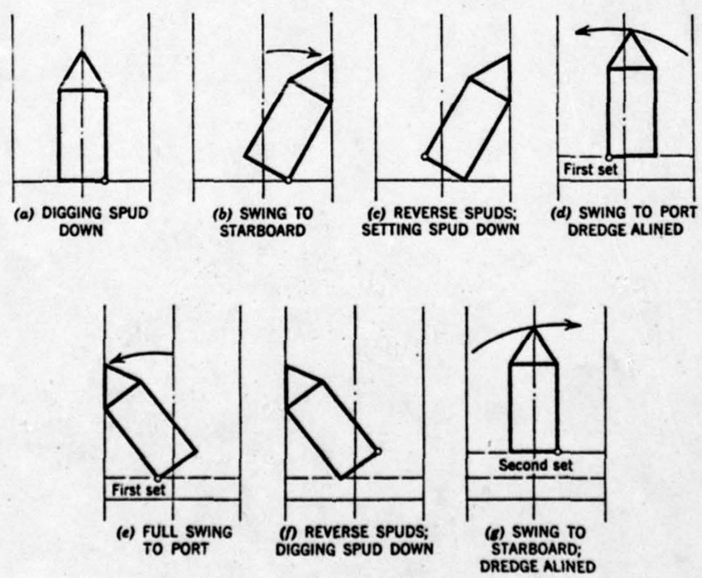


Figure 1.3: Dredge Movement and Spud Operation (14)

kind have pumps rated at 10,000 hp with speeds up to 300 RPM as a maximum.

The main engine of the dredge is used for propulsion and to drive the main pump. At the stern of the dredge are two long vertical steel poles called spuds. These poles are dropped by gravity into the river bottom and are used to position and move the dredge during operation. Spuds are usually cast iron or built up steel plate and vary from 2 to 3 feet in diameter. Spuds up to 100 feet in length are common. In very deep water or where the spuds provide insufficient strength to anchor the vessel, additional anchors are used. Also at the stern of the vessel is a steel pipeline floating on pontoons. This pipeline carries the dredged material directly from the main pump to the disposal area under a variable pressure. It is the diameter of this pipe that is normally used to classify the cutter head dredge as a whole; i.e. a 30 inch dredge. The discharge pipe can vary from 6 to 30 inches in diameter and can easily be up to 2,000 feet long or more. Both of these critical dimensions are based solely on the capacity of the main pump. The pipe can be connected in sections that extend from the dredge to the river bank or diked area for material disposal. Thus, barges are not used with cutter head dredges unless the disposal site is either beyond the pumping range of the dredge, local river conditions prevent the use of pipelines such as excessive traffic, or the material is being reclaimed for productive use. The discharge line is normally connected in a long arc to the

disposal site so that additional sections are not constantly being added as the dredge moves forward. This frequently results in creating an obstacle in the channel to normal ship and barge traffic. Quick disconnect couplings within the pipeline allow the passage of river traffic with little down time.

All of the operations of the dredge are controlled from the leverhouse where the leverman can control main pump speed, spud operation, anchor winches and cutter speed and placement. (Figure 1.7)

Cutter head dredges are moved along their intended course along a series of swings pivoting on one of the spuds as shown in Figure 1.3. After the dredge is towed or is self-propelled to the jobsite, it is initially positioned by a series of anchors forward of the dredge and to either side of the channel to be dredged. These anchors are placed either by auxiliary boats or are dropped from long arms extending out from the dredge's bow. The leverman then drops one of the spuds and keeps the other one up. He then lowers the ladder to the bottom and begins dredging. The leverman then pulls tension on the starboard side winch and swings the entire dredge to the right. Once he has reached the far right limit of the intended channel, he drops the other spud and raises the first one. He has now completed what is referred to as a "set" in dredging parlance. He now slacks off on the starboard winch and exerts tension on the other anchor on the opposite side of the channel. The entire dredge slowly moves through an

arc to the left. Throughout this process, material is being sucked up from the bottom and discharged out the pipe on the stern.

This slow swinging motion between the limits of the channel continues forward in a lumbering fashion with anchors being repositioned forward as required. Channel widths up to 300 feet are commonly dredged using this technique. (See Figure 1.8)

1.3.2.2 Hopper Dredges. A separate but similar type of hydraulic dredge is referred to as the hopper dredge. (Figure 1.9) This is a vessel that operates under the same suction system as all hydraulic dredges but differs in three major aspects. First, it is an open water vessel that can operate in seas with considerable wave height (commonly up to six foot swells). Second, a cutter head is not used. Instead, the ladder is mounted on the side of the vessel and trails along the bottom. The weight of the ladder and the motion of the ship drag the input head through the deposits. This obviously limits the type of material a hopper dredge can remove. The name itself implies the third major distinction. Hopper dredges suck the material onboard where it is temporarily stored in the ship's hold or hopper as it is called. Once full, the dredge moves to an approved dumping site where it opens submerged doors and releases its load. Some hopper dredges have the ability to pump their contents short to medium distances.

1.3.2.3 Dustpan Dredges. The dustpan dredge has all the attributes of the common cutter head dredge except that it is designed to excavate only sands or silts. Because of this, there is no need of a cutter head since the materials are not consolidated. The end of the ladder has a large wide opening (which looks like an oversized dustpan). The operation of dustpan dredges is the same as cutter head dredges. This type of dredge is most common along the Mississippi River where sand/silt deposits are so common. Because of their limited usefulness, they are limited in number.

1.3.2.4 Sidecast Dredges. Sidecast dredges are most similar to hopper dredges. They are essentially the same except that sidecast dredges are unable to store their material onboard. This is not a limitation since sidecast dredges are designed with the intention of merely excavating the bottom and immediately discharging the material at right angles to and beyond the limits of the channel. Because of this, sidecast dredges are most commonly used for maintenance dredging of existing channels where dredged quantities are limited. The obvious turbidity created by this method does pose some environmental problems.

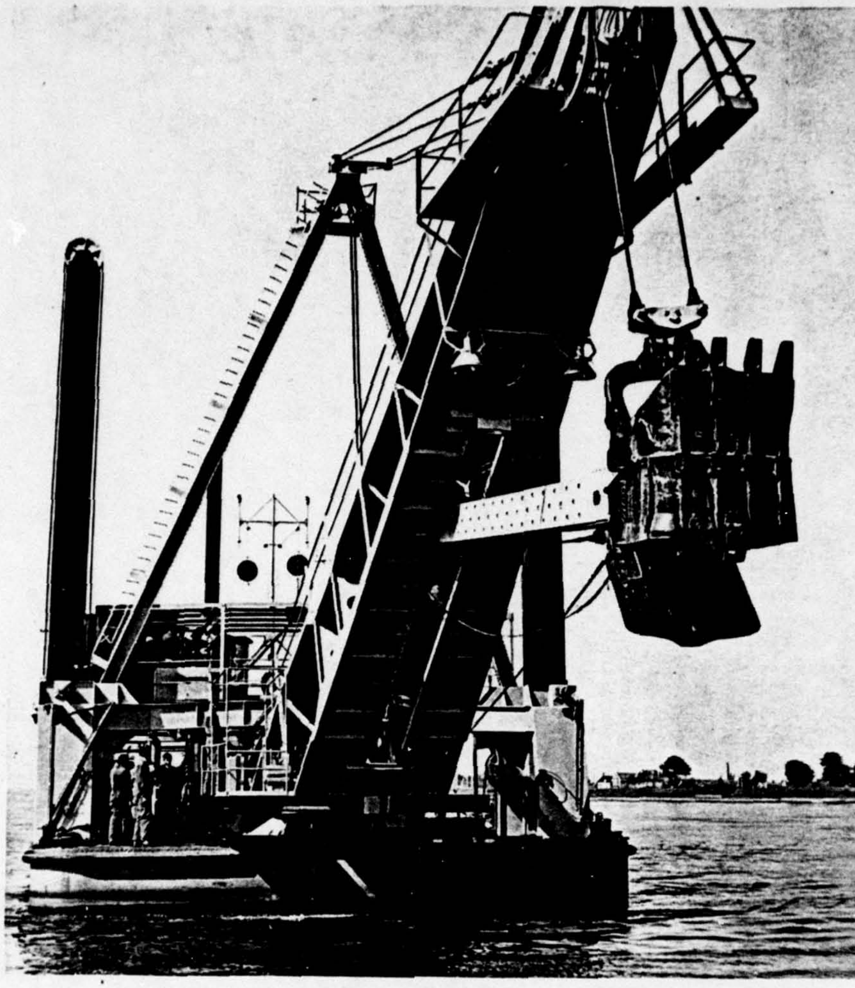
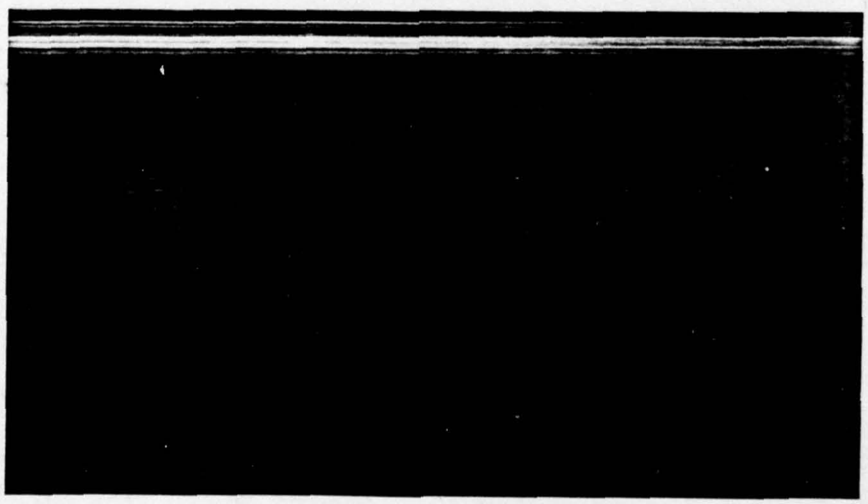
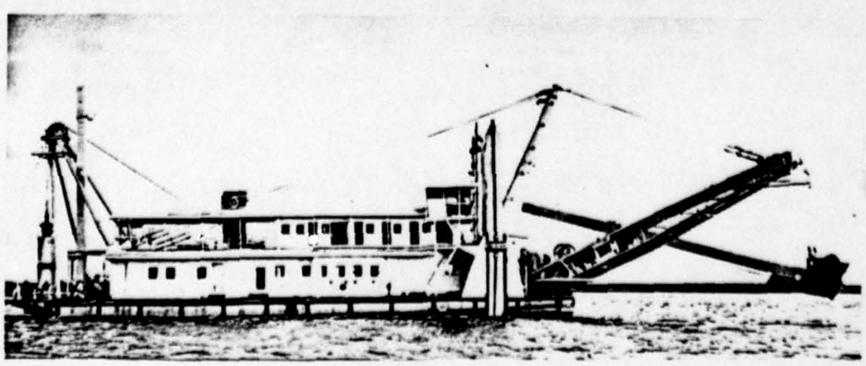


Figure 1.4:
Dipper Dredge
(15)





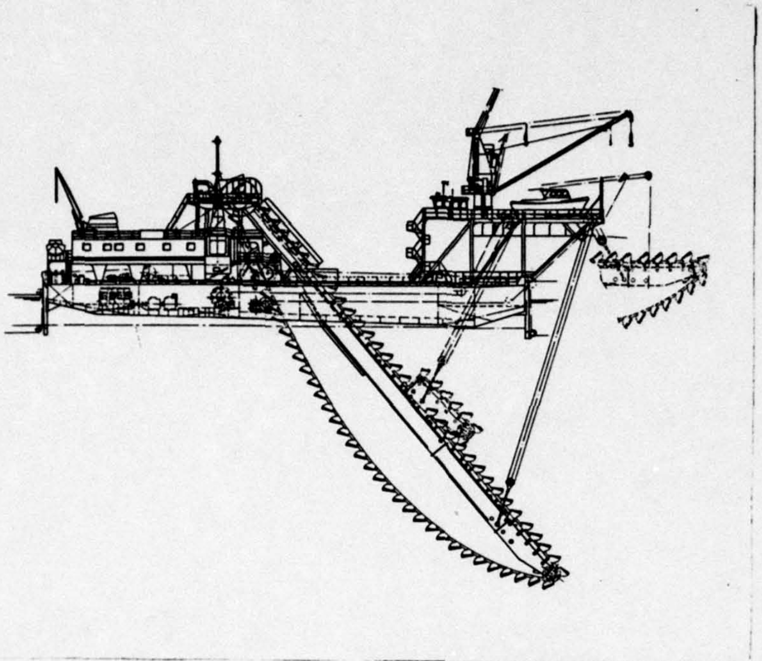
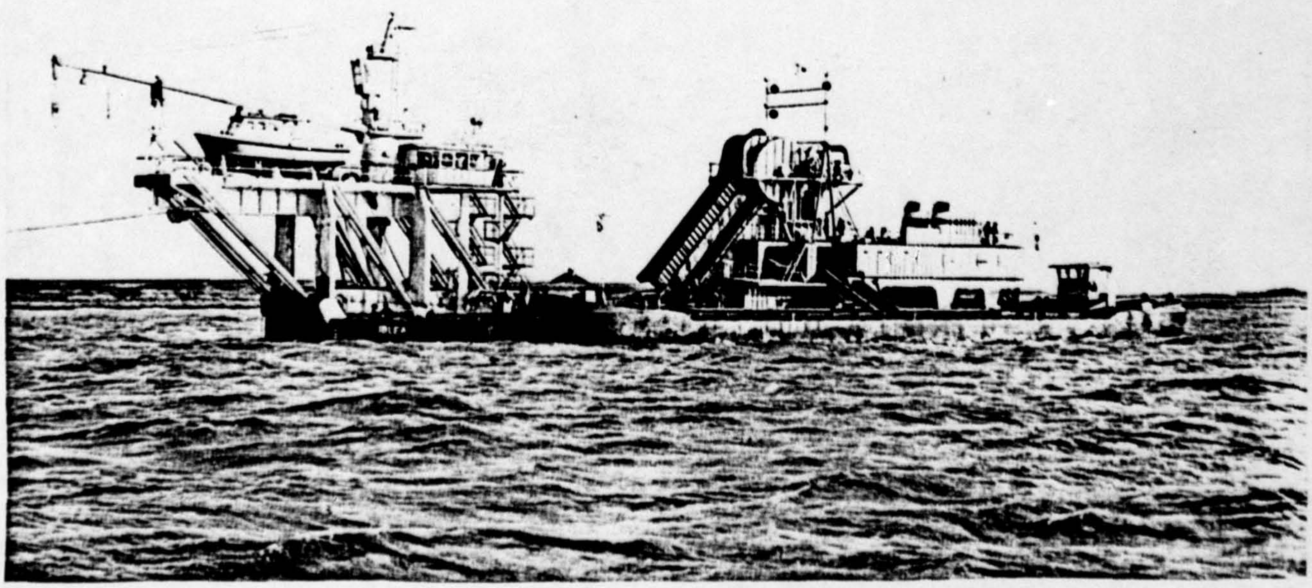


Figure 1.5:
Chain Bucket
Dredge (16)



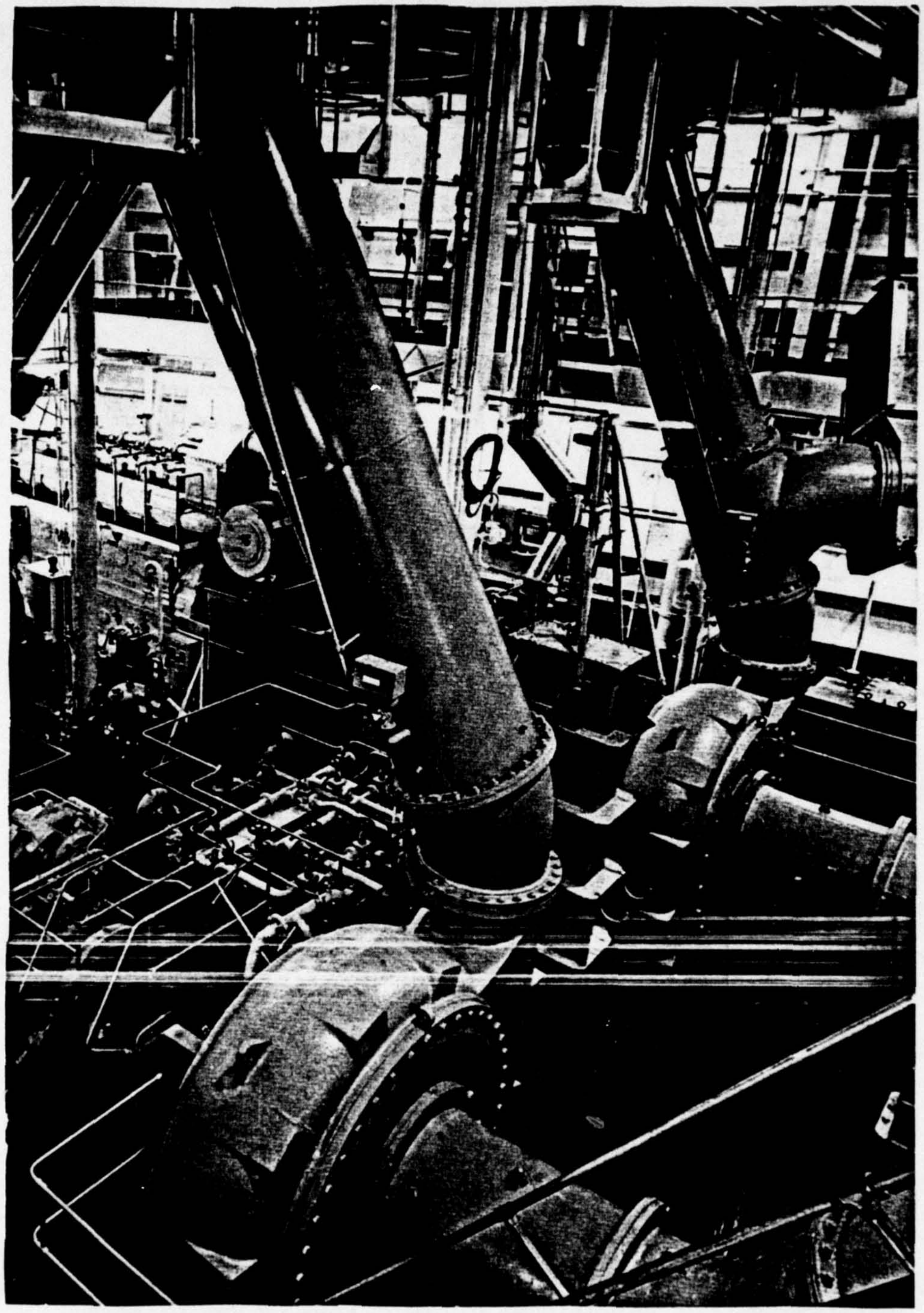


Figure 1.6: Dredge Pumps (17)

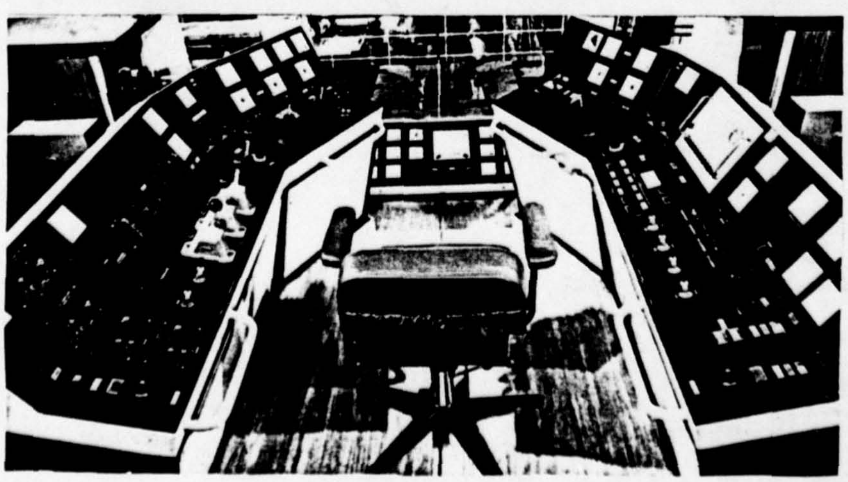


Figure 1.7: Control Room (18)

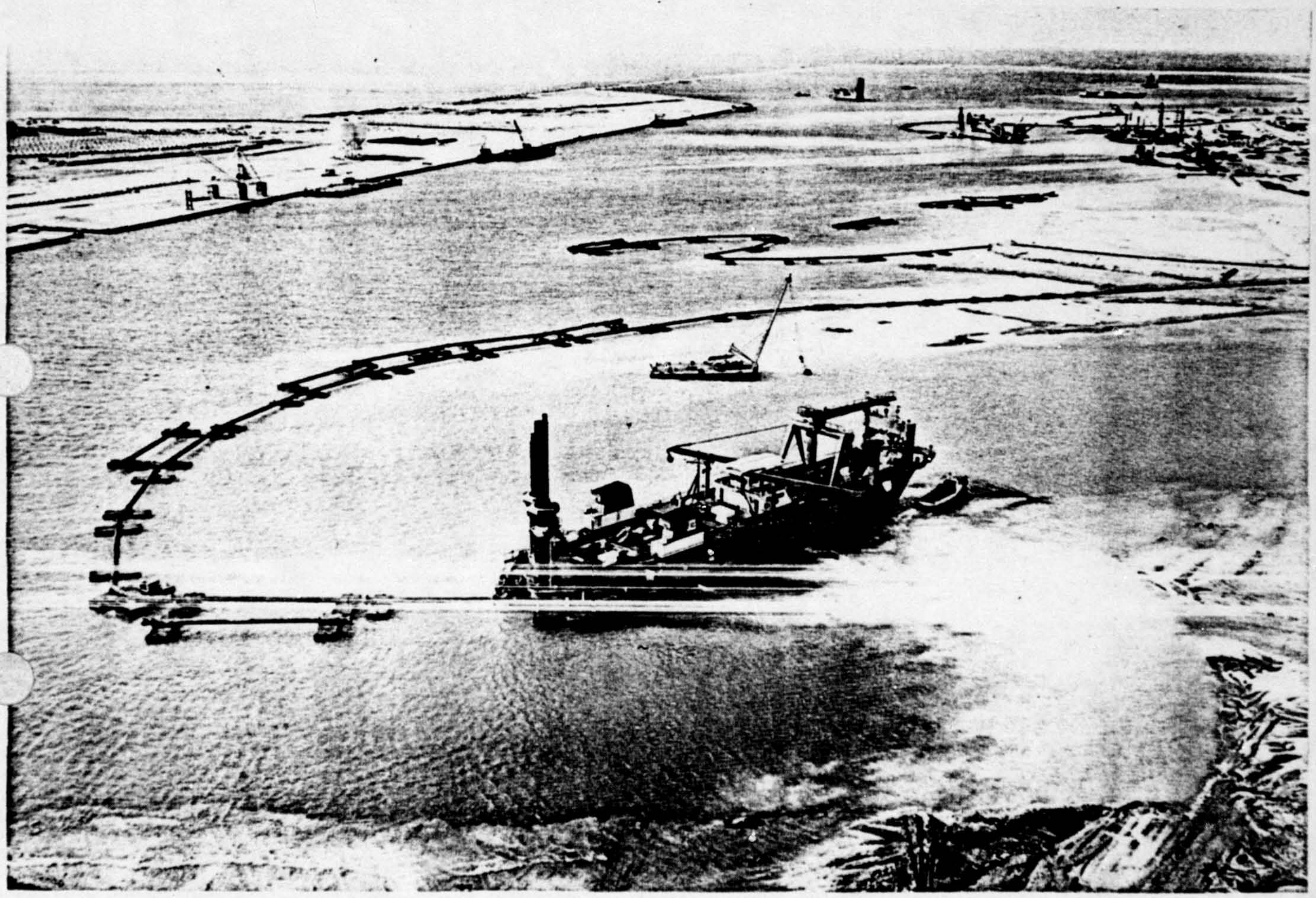


Figure 1.8: Cutterhead Dredge and Discharge Pipeline (19)

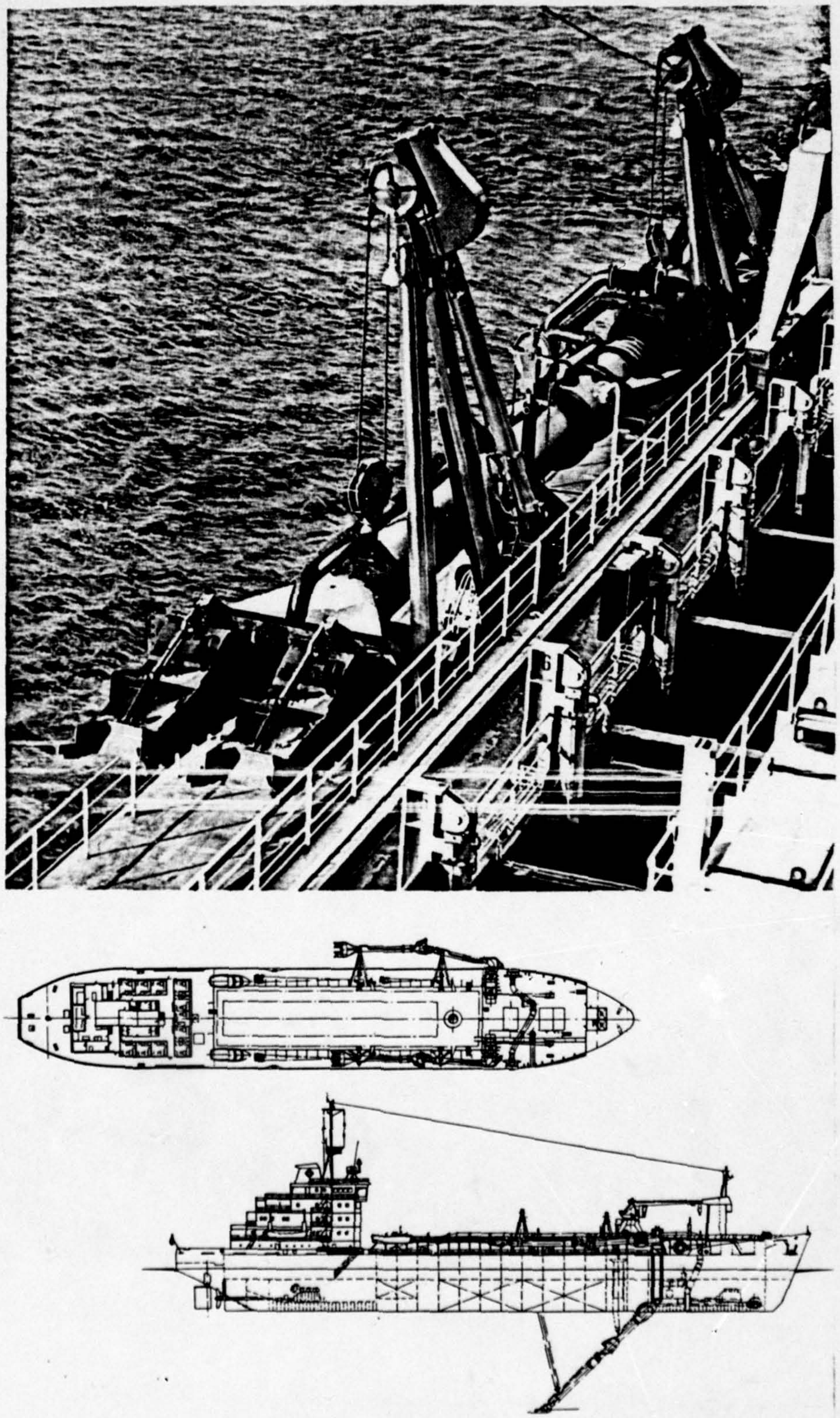


Figure 1.9:
Hopper
Dredge (20)

2. IMPROVEMENTS TO DREDGING EQUIPMENT

2.1 INTRODUCTION

Dredging is an equipment intensive and high capital investment technology which embraces a wide range of scientific disciplines. Most significantly, dredging relies greatly upon the science of rheology since the transport of material in a slurry form is the basic technique relied upon to most frequently accomplish the task. Because of the lack of research into the hydraulic transport of slurries, most of the advancements made in dredging have resulted from a trial and error approach. Therefore, most improvements have evolved from the jobsite and not the laboratory. This less than structured approach to dredge modernization is increasingly being recognized as a detrimental process by many elements of the profession with greatest pressure for change emanating from academia and some of the larger dredge manufacturers. Impeding the change is the fact that many dredge operators are either unconvinced or unaware of their ability to further optimize their on site levels of efficiency. Simply stated, "if we are to move the industry out of its extended, uneconomic trial and error period, into the modern and profitable age of science, we must understand and apply the physical and immutable principles of dredging." (21)

The greatest hindrance to achieving this goal is the fact that dredge operators are not hydraulicians but profit motivated businessmen. While these two characteristics are not necessarily mutually exclusive, it is rare to find both attributes in the common dredge operator. This has led to the typical attitude of most dredgers in which short range profitability concerns replace modernization of the technology as the primary issue.

It has not been until recently that scientific studies have been made into the dredging process with an eye towards improving the operating efficiency of the dredge. It is not the intention here to present a detailed summary of the latest rheology research or the new accomplishments in mathematical modelling of the dredging process. Recent additions to the literature adequately explain these new theoretical techniques. Similarly, the efficiency of the dredging process has also benefited from improvements in many areas of mechanical design of dredge component systems. Discrete areas of mechanical evolution have occurred in discharge lines and couplings, hydrualic, power, propulsion and electrical systems and anchoring devices to name only a few. Their application to dredge plant has elevated the modernity of dredges but does not alter dredge efficiency except in a peripheral way. There are, however, a limited number of advances in dredging equipment which significantly upgrade the capabilities of the industry. This chapter will explain the significance of these fundamental improvements and their ability to alter the pro-

ductive capacity and/or operating efficiency of dredge plant.

2.2 DREDGE COMPONENTS

2.2.1 Dredge Pumps. The onboard centrifugal dredge pump is rightfully referred to as the heart of the dredge. Its capabilities and limitations define the properties of the system as a whole. Because of this, a great degree of research into pump design is currently underway. The basics of the pump's operation are worthy of review if for no other reason than to illuminate the three major variables which limit a dredge's capacity.

The pump is most commonly mounted in the center of the dredge hull at or slightly below water level. Normally, a diesel motor applies horsepower to the pump and rotates the internal vanes of the pump. Through this rotation, a partial vacuum is created in the pump casing which induces the slurry to flow into the system. If perfection was achievable, a 35 foot tall column of water could be raised by this vacuum. Since the pump cannot create a perfect vacuum it is normally limited to creating a sufficient vacuum to elevate a column of water 30 feet in height. This upper limit is a result of the fact that the barometric pressure of the atmosphere acting on the free water surface is the sole force which moves the slurry up the intake pipe to the pump itself. The pump then creates a positive pressure on the pump casing contents,

raising the slurry velocity and forcing it through the discharge pipeline. The pump would then appear to be limited to a theoretical digging depth of 35 feet or a practical limit of 30 feet.

The apparent 30 foot digging depth (D.D.) limit is further reduced by a series of factors which also act within the intake suction line. Among these are the flow related entrance loss, friction loss and velocity head factors. These are primarily related to the design of the system but are rarely avoidable in their effect on diminishing slurry flow. These are accompanied by the factor referred to as specific gravity head (h_{sg}) which is the force required to lift the solids within the slurry from the channel bottom to the pump casing. Mathematically, it can be expressed as,

$$h_{sg} = \text{D.D. (specific gravity}_{\text{slurry}} - \text{specific gravity}_{H_2O}) \tag{22}$$

Experience has shown that during sand dredging operations, greatest efficiency occurs at a slurry specific gravity of 1.5. (23) From the above equation, h_{sg} then equates to .5 D.D. Thus, at a 30 foot digging depth, 15 feet of pump induced head is required to simply move the solids up to the pump. This leaves only 15 feet of head to overcome the other inhibiting factors occurring at the intake pipe. This does not mean that below a digging depth of 30 feet no slurry can be moved. At 60 feet for example, h_{sg} is 30 feet of the entire head produced by the pump with no residual head to overcome the other

loss factors. This is obviated by decreasing the specific gravity of the slurry so that h_{sg} is less than .5 D.D. In other words, the dredger decreases the density of slurry (decreases solids output) at greater depths to continue the dredging process. This results in an economic limitation to dredging depth and is referred to as the barometric limitation.

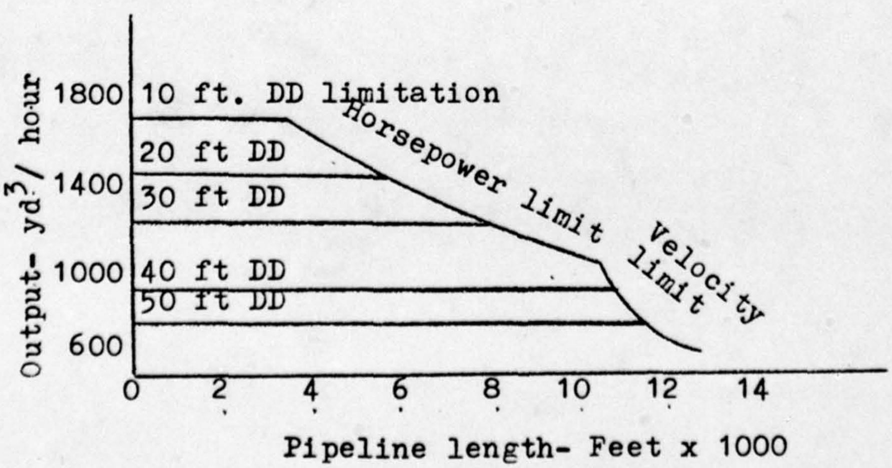
The second major factor which impinges upon the productivity of a given pump is the effect known as cavitation. This phenomenon is induced by the motion of a solid as it passes through a liquid medium. In the case of dredging, the rotating impeller vanes within the pump move through the incoming slurry at variable rates of speed based on applied horsepower. If the vanes move through the slurry at too high a speed, the slurry cannot move fast enough into the displaced volume. This creation of cavities (thus, cavitation) leads to serious decreases in pump output by drastically reducing pump head. Since the speed of the impeller vanes reflects the applied horsepower on the pump, this second major limitation to pump productivity is also referred to as the horsepower limitation. To gain maximum productivity, most dredges are operated at conditions of impending cavitation. The quantification of this limit is now being attempted. Currently, dredge operators determine cavitation limits by noting the diminution of productivity or the more immediate effects of cavitation such as loud banging inside the pump casing.

The third and final major limitation on pump productivity also relates to the applied horsepower but in a different

respect. The slurry flowing through the discharge line must be maintained at a sufficiently high velocity so that the solids stay in suspension or else line plugging will occur. Since the critical slurry velocity varies with respect to the density of the mixture, with longer pipeline lengths either velocity must be initially higher or the density of the slurry must be decreased. Thus cavitation effects and slurry velocity requirements are maximized in operations requiring long discharge pipe lengths.

By combining these three limitations, the output of a given dredge pump versus discharge length of a given dredge pump can be graphically represented. These are referred to as production charts and illustrate the capacity of a specific type of dredge operating under controlled conditions. The following figure is a representation of a typical production chart for a 24 inch diameter suction and discharge line, fine sand and 2250 horsepower diesel motor.

Figure 2.1: Hydraulic Dredge Productivity Chart (24)



It should be understood that each dredge has its own production chart which will be fundamentally affected by the specific project conditions. (See Appendix A.) Some of the variables that can substantially alter the curve are in situ density of dredged material, elevation changes in the discharge pipe over containment dikes, leakage along the pipeline, diameter of the pipes being used and losses due to the inadequate equipment maintenance. Some of these variables, primarily in situ density, can and do change during the operation of the dredge without the knowledge of the operator. The production chart for any one dredge then should not be regarded as anything more than a starting point for determining the general applicability of a given dredge to a specific project. It is at this point where many dredge operators fail to perceive the effect of job site conditions on their plant's production chart. It also helps to explain the inherent difficulty in estimating the productivity of a dredge during the contract bidding process. Because of the ill defined interplay of these variables, most dredge operators rely on past experience on previous similar projects to extrapolate their future productivity.

2.2.2 Mitigating Pump Limitations. By analyzing the limiting factors in the hydraulic dredge's production chart, it is evident that in order to increase the instantaneous output the effect of these limitations must be diminished. While

in some instances this may be required simply to make a certain project economically feasible, in all other cases shifting the productivity curve up and to the right will lead to increased productivity. Financial savings to both the customer and the contractor will then result since total project duration will decrease.

The apparent limitation resulting from barometric pressure on digging depth and solids output has been mitigated to a sizeable degree through recent advances. The traditional placement of the pump at or below water level within the hull was premised on the notion that by lowering the location of the pump less head was being obligated to elevating the slurry. The logical extension of this concept was to lower the pump even further so that the obtainable head could raise a denser slurry at greater digging depths. Dredges incorporating this idea have submersible pumps mounted on the ladder below water level. The main pump is retained in the normal mid hull position and applies the major force to discharge the slurry through the pipeline. The addition of a submerged pump on a dredge's ladder is not usually an add-on feature but is restricted to new dredge plant. Submerged pumps represent an extremely significant advancement in dredge capacity in their ability to extend dredging depths and to increase solids output at previously attainable depths. While digging depths up to 50 feet were presumed to be the economic limit on most projects, in recent years, digging depths up to 30 meters (approximately 100 feet) are becoming

common with dredges so equipped. (25) The effect of a submerged pump on a typical productivity chart is shown in Figure 2.2 "It is significant that with the conventional dredge, the output at 50 feet D.D. is approximately half of that at 10 feet digging depth. The production of the dredge with submerged pump increases dramatically at the greater digging depths, even beyond that of the conventional dredge at the very shallow depth of 10 feet." (26) It is interesting to note that the incorporation of submerged pumps was first accomplished by European dredging concerns and is only recently being applied on a significant level within the American dredging fleet.

The limitation on horsepower that can be applied to pump impellers (*cavitation effects*) is less easily visualized and more difficult to overcome. While some improvements to pump impeller design have occurred, a significant solution to the problem has eluded most dredge manufacturers. This is primarily due to the fact that the variables which affect and cause cavitation are poorly understood. "Very little information is available on the influence of solid particles in liquid-solid mixtures on cavitation effects in pumps." (27) Research devoted to understanding and ultimately controlling cavitation effects is now an intense area of interest which is being largely conducted at the Center for Dredging Studies, Texas A & M University. Mathematical modelling of dredge systems and dredge components has been accomplished with some degree of success. Cavitation effects as a function of

slurry particle size has also been investigated.

The hydraulic and mechanical variables that control cavitation are among the most esoteric yet critical concerns of the successful dredge operator. It is at this point that those in the field and academicians have yet to fully cross fertilize each other. During the research phase of this thesis, a dredging industry representative expressed the notion that some academicians were "hung up" on cavitation to the detriment of needed research in other areas of dredge technology. Similar attitudes are common and are typified by the following quote.

> I have heard time and again that the wide variety of soil types and conditions routinely encountered on any dredging project preclude one from attempting to theoretically predict dredge performance. In addition, the variety of suction geometries and large numbers of unknowns only make such predictive attempts academic exercises. Also, attempts to use laboratory scale models under controlled soil and operating conditions are said to be unrealistic and not representative of true prototype conditions. If this is true, then how can we ever hope to learn about what really takes place during a hydraulic dredging operation? (28)

This unfortunate attitude of the dredging industry has been typical in the past but is now slowly eroding as operators begin to more fully appreciate the potential benefits of ongoing research. One needs only to look at a dredge production chart to realize that mitigating the effects of cavitation would be a major breakthrough in dredge efficiency. Until now, the emphasis has been to determine the point of incipient cavitation for various conditions. The current

research may permit redesign of pumps that shift this point. Success in this regard may be a time consuming process.

While the underlying mathematics of cavitation are being analyzed, the physical effects of cavitation on existing pumps are being dealt with in some areas. Cavitation leads not only to decreased output but "as the vapor filled cavities move into the higher pressure regions of the impeller they collapse violently causing extreme stresses in the impeller surfaces which can erode the metal." (29) The combined effects of this cavitation induced wear and erosion resulting from passage of frequently large and/or abrasive solids leads to early pump maintenance problems. Operating life of impellers has been reported in the region of 500 hours in rock and pebble slurry environments. (30) Some attempts to minimize the problem are to either coat the internal pump surfaces with wear resistant materials (NiHard, Maxidur) or to employ a double walled pump. The inner casing consists of a wear resistant material which, while eroding less quickly, also permits easier replacement. Inevitable maintenance periods are thus shortened. The inner housing also permits a greater degree of safety during pumping operations. "Should the inner housing fail suddenly as a result of an explosive device being drawn into the pump, or following an extremely high pressure surge, there is no risk of the pump room being flooded." (31)

The third limitation on a production chart, slurry velocity, can be modified through the addition of a second

pump to the system as a whole. Since at long pipeline lengths productivity is mainly limited by discharge line velocity, the addition of a second pump at some point along the discharge line should be able to boost the pressure and hence velocity of the slurry. This technique of using booster pumps is a common solution for overcoming potential line plugging problems. Figure 2.3 depicts a production chart for a dredge system which incorporates a booster pump at some point along the discharge line. Booster pumps can be either land based along an elevated discharge line or can be floating plants if needed. The sizing and placement of booster pumps is largely determined by incoming slurry densities and pressures. The addition of these units is, therefore, not a straightforward "bolt-on" operation but must be preceded by a site specific computational design process.

2.2.3 Pump Summary. The three major limitations on pump performance discussed here impart the greatest restraints on dredge productivity. While two of the three factors have been significantly mitigated, cavitation remains an unsolved quantity. The research now underway is crucial to the industry and should be strengthened in its extent and funding.

The agencies involved in this area are limited to some U.S. universities and large European firms such as BHRA in England and IHC in Holland. Following increased informa-

mational transfer between these research groups and the industry, the situation appears to be improving. The time has come for U.S. dredge operators to not only welcome new research but to demand it.

2.3 DREDGE AUTOMATION

2.3.1 Introduction. The operation of the typical dredge is perplexing in the extent of the demands placed simultaneously on the operator. It is his responsibility to control ladder position, pump speed, cutter head speed, movement of the dredge while attempting to optimize solids being transported. In few industries is one man's action so pivotal to an entire organization. Realizing the vulnerability of this situation, many dredge manufacturers have attempted to augment the dredge operator's ability to more fully control the dredge. Until recently, the dredge operator was forced to rely on his senses and the "feel" of the dredge to try to maintain some semblance of optimum productivity. Fortunately, new hardware advancements have helped reduce the subjectivity of the process by quantifying the variables involved.

2.3.2 Production Metering Techniques. Of greatest interest to the operator is being able to achieve and maintain the optimum rate of solids transported by the dredge. The vari-

ables that affect this rate are numerous and clearly interdependent. Lateral force applied to the cutter head, cutter head rotation speed, digging depth, pump horsepower applied, length of discharge line, density and gradation of the in situ material all combine to control the rate of solids discharged. Research continues in modelling this process so that future dredge designs will be inherently more efficient. The problems of the existing dredge owner are more immediate and require generating a technique which permits the measurement of instantaneous solids output. Once this is possible, the operator can adjust the different factors within his control to reach optimum productivity.

Until recently, the output of dredges was determined by techniques that now appear very rudimentary in nature. The rate of solids being transported involves two major factors; velocity of the slurry and its specific gravity. One traditional and still practiced technique used for velocity measurement was to physically measure the deflection of the discharged stream at the end of the pipe. This technique is based on the observation that " a jet of water flowing from a horizontal pipe will fall with the acceleration of gravity, its trajectory forming part of a parabola." (32) By measuring the shape of the water curve, the velocity can be inferred by applying basic mathematics. The accuracy and reliability of this method is rather dubious since measurement of the turbulent stream is no more than an approximation at best. Perhaps more importantly, the velocity so calculated tells the

operator what the velocity was at some previous time. This delay increases along with discharge pipe length. Combining the velocity readings with pump vacuum and pressure gauge values allowed the operator to achieve a rough approximation of optimum efficiency.

A more accurate and timely solution to the problem is now available and is incorporated in the design of all new dredges. The measurement of instantaneous output rates can best be measured through the use of two electronic instruments known as magnetic flowmeters and radiative density meters. When used in conjunction, the total system is known as a production meter.

Magnetic flowmeters are electrical devices mounted near the beginning of the discharge pipe and do not require the introduction of any mechanisms into the flow stream. Since large abrasive particles rapidly move through the pipe, the ability to measure velocity by inference is a prerequisite to any successful design. Magnetic flowmeters operate by applying Faraday's Law of Electromagnetic Inductance. The solids moving through the pipeline are conductive in nature and cut across an induced magnetic field operating at right angles to the flow in the pipe. Electrodes are imbedded in the pipe and are set flush to the flowing medium. "The conductivity of the dredging flow stream is more than ample to meet the minimum required for successful operation which is about 10 micromhos per centimeter." (38) The response time and accuracy of the magnetic flowmeter are quite high

with only 2 or 3 seconds required for a full scale change and accuracies up to ± one percent are obtainable. The degree of accuracy is, however, dependent upon the homogeneity of the dredged material. Any resulting errors are said to be minimal in nature.

The determination of the specific gravity of slurry is the second and final procedure and is most accurately arrived at through the use of a radioactive density meter. These devices are essentially the same as those used to determine compaction of in place base courses during road construction. The meter is also mounted on the discharge pipe where it irradiates the slurry through the use of a gamma ray source. Based upon the absorption rate of gamma rays by the solids, the density of the slurry can be deduced. "Since the presence of significant amounts of entrained air or gas precludes accurate measurement by this method, care must be taken to select a section of pipe that will always be completely filled; the meter should not be located where cavitation bubbles form, gas comes out of solution, or air leaks into the system." (34) Meter placement should also take into account the fact that the solids normally flow near the bottom of the pipe, not uniformly along the cross section. Placement on vertical sections of the pipe is thus sometimes preferred. The system is accurate to within ± 5 percent of the true density if properly calibrated and maintained. The stringent safety requirements and need for frequent calibration are two major common complaints with these devices.

The readouts of the two meters are combined in an analog computer which translates the velocity and density into a solids flow rate; normally measured in cubic yards per minute. This can be integrated by a totalizer to provide production over any time interval. Many types of these production meters are currently available from both American and European manufacturers. Some systems rely on pressure differentials along a segment of the pipe to measure slurry velocity. An example of this type of system is the Ellicott Production Meter System, EPMS, shown in Appendix B.

The use of production meters has markedly increased in the recent past with all new dredges incorporating them in their initial design. Although they can be retrofitted into existing dredges, their use on these vessels has been limited. The unwillingness to adopt new hardware is not solely a function of their high initial cost but also reflects the attitude of many dredge operators who remain unconvinced of the necessity of these instruments. The reported accuracies and reliabilities of these systems has been disputed by some who appear unwilling to accept the notion that a machine can outperform an experienced dredge operator. The ability of the production meter to quantify a complex situation is, nevertheless, an extremely significant adjunct to the knowledgeable operator. As stated elsewhere, "I cannot overemphasize the importance of such intelligence to the dredgeman in optimizing the operation of his dredge, both from an economical and environmental viewpoint....Regardless of how smart and experi-

enced operator is, a less experienced operator with a production meter can outproduce him." (35)

2.3.3 Inducing Greater Use of Production Meters. The state of the art has clearly reached the point where production meters can appreciably aid the dredge operator in maintaining his system at or near optimum levels for a greater period of time than if not so equipped. The publication of documented increases in productivity arising from their use would greatly aid in dispelling any lingering questions as to the economic justification for their use.

While the economics of the bidding and contract award process should favor those utilizing production meters, this implicit inducement does not appear to be strong enough for the average contractor. Modifying contract provisions to increase the use of these devices could be attempted. Since the systems can provide a permanent record of productivity, any sustained high level of production over a predetermined minimum value, could be rewarded by incrementally higher unit prices. Thus, if the contractor can prove he has operated near optimum levels for a given period of time, he would be justified in reaping a monetary reward for early project completion. If this procedure was considered to be inadequately quantifiable, the same result could be achieved through the use of bonus clauses for early completion.

At present, early completion is rarely if ever rewarded.

The opposite is however true. The use of liquidated damages is not intended as a penalty for late completion but rather as reimbursement to the user for costs incurred due to untimely completion. The effect on the contractor is, however, indistinguishable from that of a penalty. The contractor therefore routinely proceeds up to the allowed completion date since early completion does not usually allow him to accomplish an extra job in the time saved. The time required for contract award, mobilization and demobilization usually precludes "picking up" a short job. Therefore, a contract provision in the form of an early completion bonus appears to be able to fill a justifiable need. There now is little incentive after the award phase for early project completion.

In these times of spiralling unit costs, modernizing and increasing the efficiency of the existing fleet should be an underlying consideration for both the contractor and the user. If typical levels of productivity are not improved, marginal contractors will continue to fail at the present alarming rate and users will be forced to suffer from needlessly inefficient and costly operations.

2.4 BUCKET WHEEL EXCAVATORS

Another new innovation which bears explanation is a different approach to the traditional design of hydraulic dredge cutter heads. The typical arrangement is a round

assemblage of steel teeth which rotate into and dislodge compacted sediments. While the design of such cutter heads has been adapted to sediments of various densities, their inherent efficiency has been questioned by some. Their adequacy in directing the flow of dislodged sediments in an efficient manner is considered less than optimum. A new cutter head design purportedly overcomes these limitations. As seen in Figure 2.4, the use of a bucket wheel design in place of the typical round cutter head now promises increased productivity and better grade control. Best suited for dense sediments, this excavator can introduce larger quantities of solids to the intake suction pipe since the material is forced in that direction by the rotation. This yields greater productivity at lower cutter head speeds. A diminished degree of turbidity also results from the use of this device. Bucket wheel excavators have found their greatest application in industrial mining operations but may have beneficial applications in typical maintenance dredging operations.

2.5 TRAVELLING SPUDS

A similar improvement in dredging efficiency is reported through the use of what are known as travelling spuds. This new design concept, which is limited to new dredges under construction, alters the way in which spuds are used to anchor

the dredge. The spuds are mounted in wells at the stern of the dredge but are able to slide along the longitudinal axis of the vessel. They are hydraulically controlled and can be forced along their tracks thus moving the dredge as a whole. This permits a greater degree of control in applying force to the cutter head. The arrangement also reduces the number of sets required along the channel centerline and thereby increases productive dredging time. This concept also reduces the likelihood of spuds slipping back into depressions generated by previous spud sets.

2.6 PROSPECTS FOR FURTHER DEVELOPMENTS

The field of dredge design improvements and the rate of construction of new dredge plant are closely tied to the economic incentives in the market place. Although the demand for dredging is relatively constant, the declining health of the industry in America in recent years results from low profit margins and inefficient operation. While the construction of more modern plant would seem to be a major part of the solution, the high initial capital costs have prevented new construction for all except the largest operators. Therefore, while new advances in hardware and fundamental dredge designs have occurred, the common dredge operator is hard pressed to incorporate them into his existing plant. Because of this, it appears likely that the current

division between the small and larger dredging firms will widen with time. Unless inducements for fleet wide improvements are put in place, the small to moderate scale operator may find himself priced out of the market because of a persistent aversion to change. As efficient operators increase in number, this traditional attitude in the dredging industry takes on added significance.

The improvement of dredge plant efficiency can be seen as a two-fold process. Existing dredging equipment can be upgraded through the application of new hardware and improving on an incremental basis dredging components. While this can improve the general level of operation, no fundamental changes will probably result. If applied in aggregated form to newly constructed equipment, the improvements should however prove economically attractive. The second choice for revolutionary improvements lies at the end of current research programs. As previously stated, the dredging process itself is relatively poorly understood with most designs premised on empirical assumptions resulting from trial and error techniques. Continuing and expanding the current research programs is a prerequisite if evolutionary changes are to occur. It is encouraging to note that the Corps has requested Congressional funding for the construction and operation of a dredge devoted solely to research in this field. Greater cooperation between universities, the industry and those in government must be fostered through such organizations as the Western Dredging Association (WEDA) if the current state of affairs is to be altered.

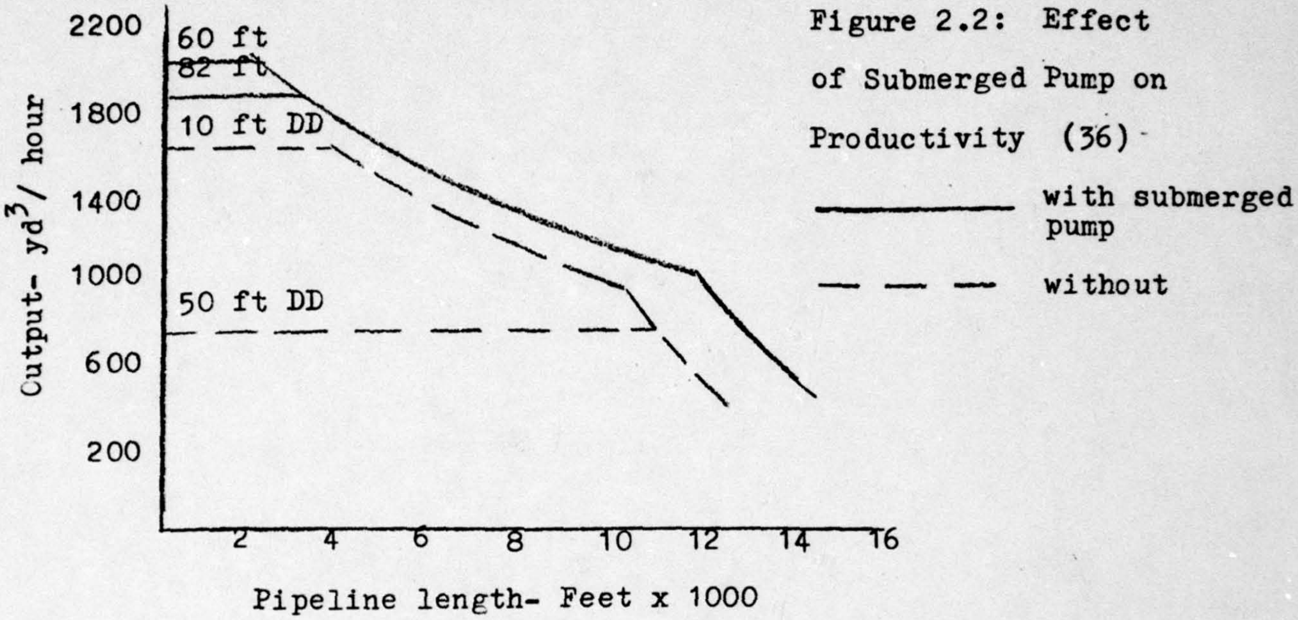


Figure 2.2: Effect of Submerged Pump on Productivity (36)

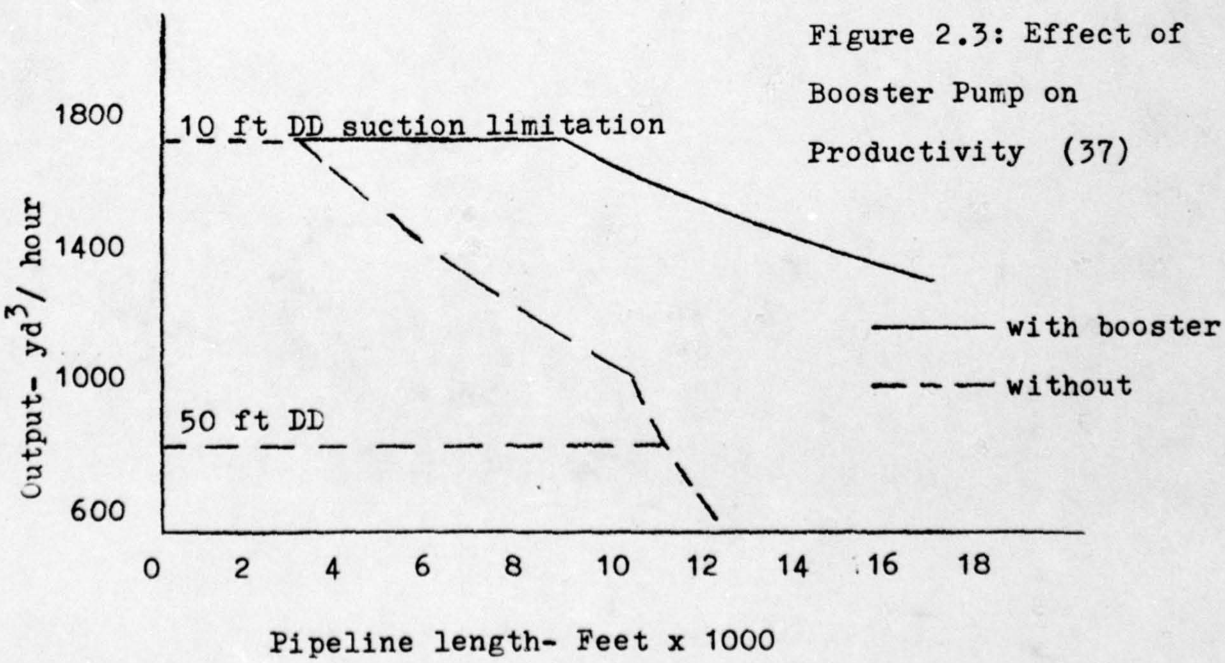


Figure 2.3: Effect of Booster Pump on Productivity (37)

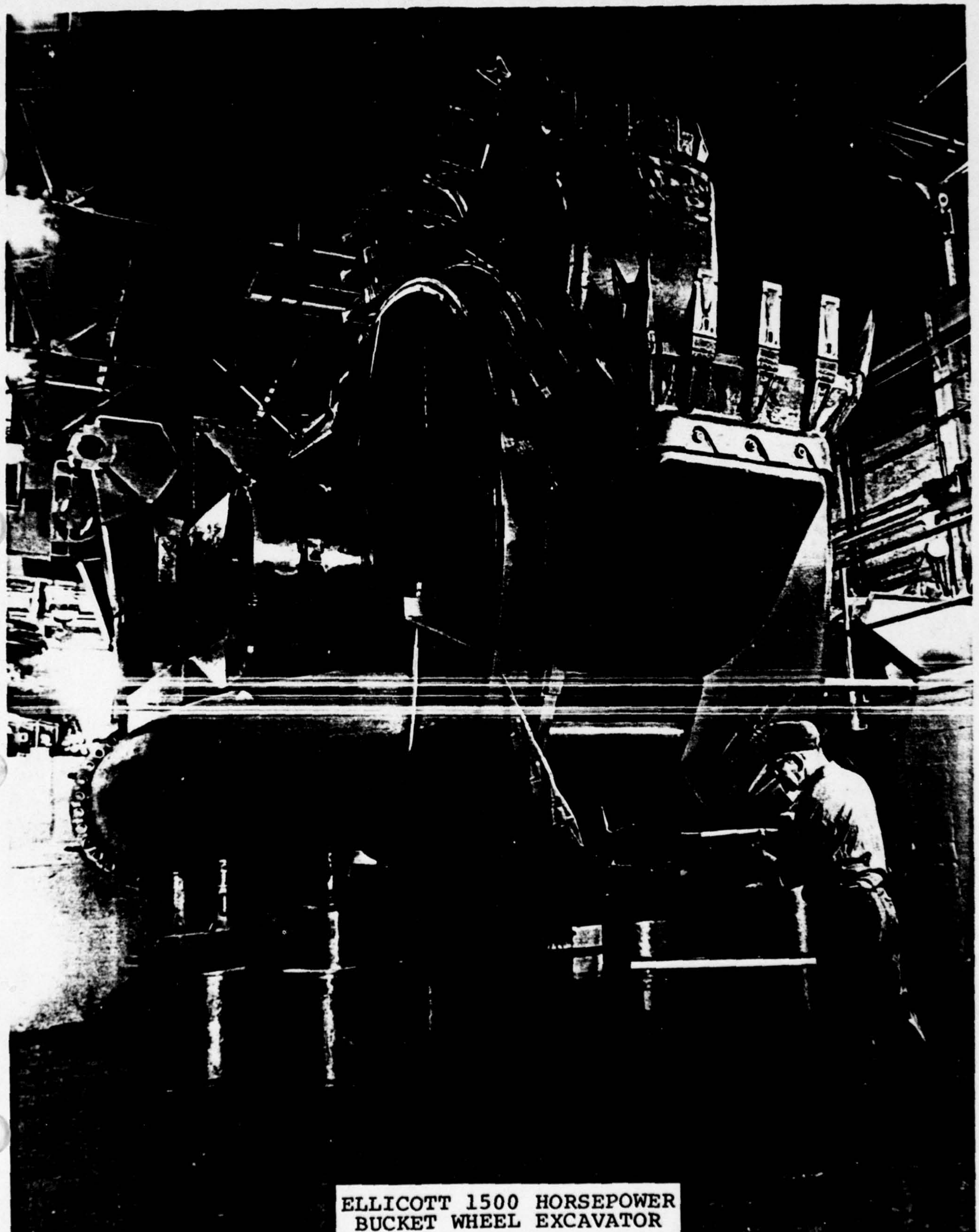


Figure 2.4 (38)

3. PROJECT MANAGEMENT FACTORS

3.1 INTRODUCTION

The planning and execution of dredging projects reflects many of the vagaries implicit in the dredging process. Most other construction disciplines deal with relatively easily quantifiable processes that lend themselves to rather explicit estimating and management control procedures. In building construction, the amount of material required can be specified with great accuracy. The number of columns in a building, for example, is static and obviously not time dependent. The construction site usually lends itself to thorough soil investigation during the design phase so that foundation designs can be matched to local conditions with a relatively large degree of confidence. As construction progresses, contract inspectors are able to exert their full efforts by visually monitoring the work in progress. This is not to say that the traditional forms of construction are problem free or that they do not have inherent planning and control limitations. The comparative ease with which these functions can be accomplished is, however, dramatically divergent from the project management limitations that naturally flow from the typical dredging project. The dredging project planner and manager must accomplish all of these traditional

functions but must do so while peering through a largely opaque medium: water.

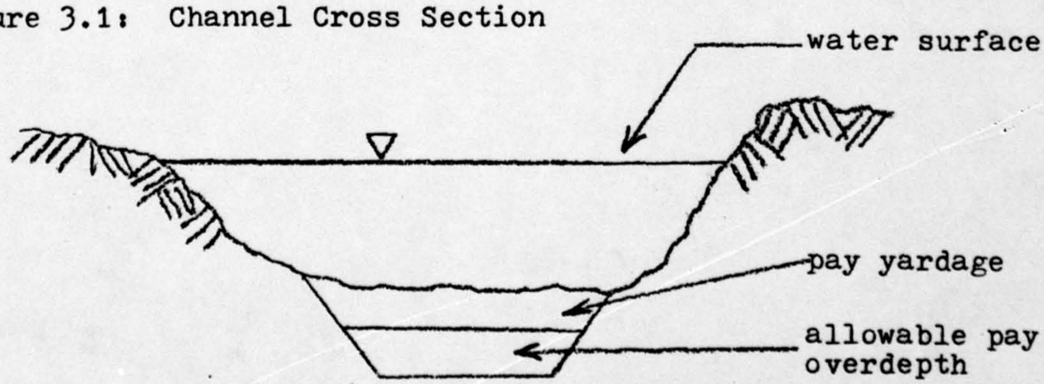
The necessary functions of site investigation, project estimating and management are routinely accomplished but must be adapted to the peculiarities of the dredging environment. These functions have progressed slowly over the years and, to some extent, have lagged behind advances made in other dredging processes. As will be seen in a later chapter, the cost of dredging is going through a period of dramatic increase spurred on by a number of discrete variables such as environmental legislation, increased fuel and operating costs and other factors. The cumulative effect has been to drive up unit dredging prices throughout the United States. The capacity to dredge more volume for less money should be a primary area of investigation since federal and private dredging funds are not an inexhaustible commodity. At some point, the economics of dredging may override marginal projects and preclude their completion. Improvements in the management and planning of such projects may be the deciding factor in allowing them to come to fruition.

The purpose of this chapter is to review those elements peculiar to dredging project planning and management that currently result in less than precise cost containment capabilities.

3.2 INACCURACIES IN PROJECT ESTIMATION

The ability to specify accurately what must be accomplished is a fundamental requirement of any construction contract. If the contract documents are imprecise or do not reflect accurately the current site conditions, the ultimate success of the project is dubious from the start. In this regard, dredging has always labored under less than precise definitions of scopes of work. Typically, the area to be dredged is shown in the contract drawings by defining the channel centerline and specifying channel bottom cross sections along the proposed centerline. Figure 3.1 is an example of a typical channel cross section and shows current bottom contours and proposed bottom contours following dredging.

Figure 3.1: Channel Cross Section



The contract documents define the limits of the proposed channel based upon the requirements of current and projected ship and barge traffic. The channel is presented

in a plan view upon which are superimposed a series of bottom depths along the proposed work site. The amount of material to be dredged equates simply to the volumetric difference between the existing and proposed channel cross sections.

The existing bottom is usually not a uniform plane surface but undulates along the course of the channel and reflects the sandbars, sinkholes, rock outcroppings or whatever other conditions may exist. The ability to accurately depict the existing bottom elevations is, therefore, a crucial step in estimating the amount of material that must be removed by the contractor. The most common procedure used in this regard is the fathometer or depth sounder which is mounted on a survey boat. This electronic mechanism generates sound waves which echo off the bottom back to the moving survey boat. This boat moves along the proposed work site and follows precise headings until the entire channel has been studied. In most instances, the fathometer generates a hard copy graphical representation of the bottom along the course it followed.

This "pre-survey" of the project site is instrumental to the estimating process but is affected to varying degrees by a series of factors that are not readily apparent. Among the vagaries inherent in the use of fathometers are inaccuracies in areas where fluff conditions exist. Fluff, or fluid mud, is a typical bottom sediment in many areas and is characterized by a transition layer of material which

increases in density with depth. This ill-defined material can be visualized more as a transition zone from water to underlying sediments than as a precisely definable strata of material. The fathometer has difficulty in delineating the extent of this material, "thus causing confusion as to the location of the 'real' bottom." (39) An additional error can be introduced by the fact that the fathometer senses objects on or near the bottom other than the sediments themselves. "The echo sounder trace will normally show echoes received from many sources in addition to the sea bed--such as fish, seaweed, airbubbles, and suspended material...." (40) All of these conditions will indicate greater potential dredged volumes which may not actually need to be removed. Since the vast majority of dredging contracts are on a unit price basis. this variation in estimated quantities can result in bids that are not predicated on actual site conditions.

The fathometer's inability to distinguish seaweed from sediment also extends to its inability to locate debris that may enter the dredge and possibly cause a breakdown of equipment. This is, however, a relatively infrequent occurrence on most jobs.

The fathometer operates by measuring the speed of echoes. A further variable is thus introduced by the fact that the fathometer must be calibrated to local water temperature and salinity conditions. Without proper calibration, which may need to be updated as conditions change during survey operations, the data accumulated will be randomly skewed

in one direction or the other.

The fathometer operates on a moving platform that translates in all three axes simultaneously. The survey boat not only moves along the channel but also varies in elevation as the vessel is affected by waves and swells. "Sea and swell are normally the largest sources of depth error and in the great majority of surveys it is not corrected, nor can it be corrected with the equipment normally used. The error so induced is obviously a function of sea conditions and can be eliminated to some degree by conducting the survey under calm conditions. This can result in time delays which equate to unprogrammed expenditures. The problem is that an echo trace of a flat bottom taken from a boat traveling through a two foot swell and a 200 foot effective wave length would appear identical to a trace taken in flat calm over a sandwave of similar conditions and the surveyor selecting soundings subsequently must assume that the latter is the case in order to stay on the side of safety." (41)

Beyond these problems involving fathometers, is the human consideration that sufficient training and experience is required before operators are able to read or interpret fathometer strip charts. Spurious readings can be detected and removed by the experienced operator. This ability, however, requires time and practice on the survey boat.

These various errors in the fathometer are compounded by the second major element of the survey process; namely, position fixing. This is the process by which the location

of the survey boat is recorded in order for the depth soundings to be matched to their location in the channel. The most common position fixing system utilizes a microwave line of sight process. The ability to precisely locate the survey boat is a problem that has undergone major progress in the past years. Application of laser tehcnology to the problem is one example of the rapidly improving state of the art in position fixing. The majority of dredge owners, however, have not adopted these newer techniques and most still rely on microwave systems. While their accuracy is quite high, there remain problems in the interpretation of positional data and in synchronizing the depth reading and position fixing processes.

The cumulative effects of the errors that result from sonic depth determination and position fixing has led to inaccurate estimates of the volumes of dredged material in most contract work. These estimating errors can be seen as dependent upon weather, location, temperature, bottom density, the human element and a series of other factors that are rarely encountered in most other construction industries. It would be of value to determine the extent of these errors in the estimating process so that the scale of the issue could be determined. A simple comparison of estimated quantities with actual dredged volumes would appear to be the most straightforward process. This cannot be done since dredged volume measurement most commonly is accomplished by post dredging fathometer surveys. Hence, the inherent errors

of the estimating process are reproduced in the "inspection" process. The importance of these errors is maximized at this point since most contracts are on a unit price basis where the contractor is paid on the basis of volumes removed as measured by the post-dredge survey. While this inherent error rate is difficult to define, if a 5% error level is assumed, in the context of a 100,000 cubic yard project at a unit price of 75 cents per yard, the error payment equates to $3750. The importance of this error is relative to who is measuring it. Since errors can be above or below the true value, the error payment could be over or under payments to the contractor. However, if the error rate is assumed to be constant between pre-and post-dredge surveys, they could cancel each other out with no resultant effect on either contractor or customer. The constancy of these error rates is not readily determinable and should be an area of interest to both contractor and customer. It can, however, be demonstrated that post-dredge surveys are more accurate than pre-dredge surveys since bottom conditions following dredging are more plain and distinct than prior to the dredging operation. The operator's ability to interpret pre-dredge surveys is thus more important since it is within these surveys that erroneous readings are less easily interpreted.

In order to provide an independent check on volumes of material removed, some agencies such as the Corps of Engineers also keep records of dredged volumes on the basis of bin yardage or scow measurement. These two techniques

are essentially the same process and are utilized on either hopper dredge operations or where dredged material is removed from the project site in towed scows (barges). In this process, the displacement of the loaded vessel is used to determine the volume of material actually being moved. It suffers, however, from the fact that the in situ density of the dredged material must be approximated so that vessel displacements can be converted into dredged volume being transported. This approximation process coupled with the ill-defined water content of hopper loads makes this a less than totally precise volume measurement system. The typical hopper dredge operation adds another factor to this imprecise technique in that hopper bins are allowed to overflow until the dredging process fills the bins to capacity. As excess water overflows, it carries with it fines suspended in the overflow water which, while initially dredged, are allowed to be reintroduced to the channel. Whether or not this material ultimately resettles in the channel or is carried away by local currents is clearly dependent on site conditions. It does, nonetheless, further complicate the volume measurement procedure.

The imprecision of the volume measurement systems currently in the field is paralleled to some degree by the imprecision of the dredging operation itself. The dredge operator attempts to maintain as close a tolerance with the required channel depths as possible so as not to overdredge. The operator's degree of control and exposure to various

elements such as weather, wave action, tides, etc., all lead to a built-in ability to dredge to a distinct plane at the channel bottom. Realizing this, most federal dredge work allows payment for overdredging usually to maximums of 2 feet below required dredging depth in order to compensate for the unavoidable imprecision of the work.

The "allowable pay overdepth," as it is called, often is an enticement to accomplish additional dredging for both dredge operators and Corps personnel. "Once a dredge is on station, the contractor is motivated to remove as much material as possible provided that he does not have to blast or cut rock. In effect, the pay overdepth provides an opportunity for the contractor to generate additional revenue; and, as long as the revenues earned in pumping pay overdepth cover more than variable costs, he is generating additional contributions to his profit." (42) Allowable pay overdepth is also viewed by some Corps personnel as a chance to accomplish future maintenance dredging ahead of schedule. The increased channel depths will not require successive maintenance work until a date further in the future. This may garner savings over the long run due to the current inflationary conditions. The efficacy of routinely overdredging channels must be considered in this light as long as unit prices increase with respect to time.

It would appear prudent for some research to be conducted in the area of dredged volume error analysis so that the vagaries of the process could at least be quantified.

Through statistical analysis of the procedure, determinations could be made of the most error free procedures to include optimum frequency of fathometer readings, optimum mix of fathometer/leadline measurement or applying other techniques. As long as monies are paid on the basis of unit prices, the yard stick used to determine the volume dredged should be as well defined as possible.

As currently practiced, the volume measurement techniques are viewed as being as precise as possible. Lead line soundings (using a weighted rope of calibrated length) to corroborate fathometer readings are frequently done when any disputes arise. This is, however, a time consuming practice. In addition, pre- and post- surveys normally extend beyond the limits of the channel to areas where no dredging has been done. Any divergence between pre- and post-dredge surveys of these non dredged areas immediately indicates an error in one or the other surveys. Identical readings indicate great reliability throughout the survey site. Nonetheless, accuracies of $\pm$ .1 foot are the best that can be achieved and tend to reflect the greatest accuracy of the system as a whole. This can very easily amount to sizeable volume errors and subsequent error payments on moderate to large scale projects.

The reader should not misconstrue the volume measurement process as wholly unreliable but should be aware of the inherent inaccuracies of the systems presently in use. Some major advances in the field allow greatly more accurate re-

sults such as the Hydrocarta (IHC) automated survey systems. This system utilizes on board computers and magnetic tape storage which combine to decrease error rates and vastly improve accuracies beyond strip recorders. The on board minicomputers automatically consolidate positional and depth data. They can be programmed to delete spurious spikes which result from sunken debris or conditions resulting from other than the bottom itself. Initial costs may be prohibitive to other than the larger dredge operators. (Appendix D describes a similar system.) Until these advanced systems find greater utilization, the current techniques should be understood for what they can and cannot do.

The timing of these surveys is also important since bottom conditions are time dependent. Shoals appear and recede with time with resultant fluctuations in volume in response to storms and other short and long term phenomena. While it is common practice to provide bottom contour surveys along with invitations for bid, the time period between when the survey was made through the design phase and up to the start date can easily be weeks or even months. The prudent contractor should update these surveys prior to construction in order to release himself from total dependence upon customer generated pre-dredge surveys.

3.3 SIGNIFICANCE OF MOBILIZATION/DEMOBILIZATION COSTS

A separate but equally significant element of the project

estimating process is the cost of mobilization/demobilization (MDM) for the contractor's plant and personnel. The proportion of MDM costs to total project costs cannot be stated with any degree of accuracy but proportions of up to 30% of total project cost frequently occur. The ability of the contractor to accurately determine his MDM costs is far greater than the Corps estimator who must rely on one MDM cost when generating the total government estimate even though many geographically separated firms may bid the job. Inclusion of MDM costs in estimates are not peculiar to dredging projects but their effects on the final contract value are greater than in most other endeavors.

Research has been conducted (43) on the manner in which MDM costs are estimated by Corps personnel. The current system is less than uniform and reflects the non-homogeneity of dredging by region and type of work. One basic assumption that must be made by the Corps estimator is the point of mobilization of the contractors' plant. Corps District Offices vary in their methodology with using "the farthest point at which suitable contractor plant is available while others select the point at which the 'second closest dredge of appropriate size for the job is currently located.' " (44) The spread of techniques the different regions use are described below:

> New England--the average coastwise distance for contractors in the vicinity who are expected to bid;
> Wilmington--from the farthest point at which suitable contractor equipment is available;

> Vicksburg--from New Orleans;
> Memphis--New Orleans or 752 miles;
> San Francisco--if adequate equipment is available in the area, use 50 miles. If not, from the point where adequate equipment is available;
> Detroit--average based on the location of three dredges that might do the job and then pick a harbor at that distance. If there is a likely dredge in or near that harbor, then use it as the assumed mobilization point;
> St. Paul--from the farthest potential bidders home port;
> Galveston--from the location of a dredge likely to do the work (both suitable and available). (45)

Once the geographic mobilization point is assumed, the Corps estimator then allows the potential contractor a certain amount of time for preparation for transfer. This depends largely upon the size of plant required and can vary from two days for small dredges (up to and including 16" diameter) to four days for larger equipment. This preparation time is then added to the time required for the transfer of the dredge from the assumed mobilization point to the project site. Transfer time depends directly upon the transfer rate or, essentially, speed of movement of the plant. Again, Corps District Offices differ here with some assuming 3 to 6 miles per hour depending on whether the dredge moves up or downstream. Others use daily distance rates such as 12 miles per day (St. Paul District) or 60 to 70 miles per day (Galveston). (46)

Time is also allowed for the setting up of contractor plant once it has arrived on site. The spread of District Offices here is more uniform with most allowing one or two days.

The demobilization estimating process is also non-uniform throughout the nation. Most assume that demobilization costs are the same as mobilization costs minus setup time costs. The St. Louis and Buffalo District Offices assume that DM costs are half of M costs. Some Districts do not assume that contractor plant returns to its home port since most dredges proceed on to other jobs. In these Districts, DM is based on the assumption that the contractor plant moves to the "nearest safe harbor." (47)

The effect of these MDM estimating procedures is two-fold. Obviously, the procedures used differ geographically thus resulting in different MDM estimates depending on who generates them. Equivalent projects then could have different MDM estimates. Secondly, and more importantly, the feeling exists that most Corps derived estimates for MDM overstate the actual costs incurred by the contractor. MDM costs are typically lump sum items on the contract, and are paid in accordance with the successful contractor's bid. But contractors know how the government estimate is arrived at and, presumably, take that process into account when they generate their bid.

As previously stated, Corps MDM estimates are usually based on the presumed mobilization point being the contractor's home port. Sequencing two consecutive Corps contracts can thus permit the contractor to be paid twice for transfer from its home port. Since typical MDM cost can easily approach 30-40% of total contract value, the issue of the

accuracy of these payments is very significant. In extreme cases, MDM costs can exceed total dredging costs.

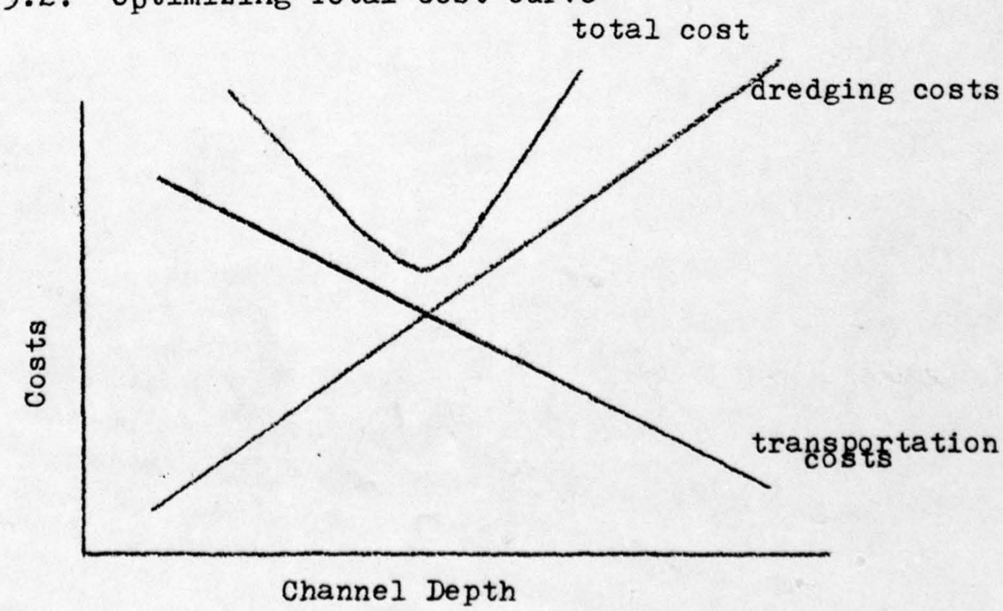
The issue of Government derived MDM estimates extends beyond their ability to forecast contractor incurred expenses. Contractor derived MDM bid items are frequently used to unbalance the total bid since Corps contract provisions normally allow for 60% of MDM lump sum items to be paid once the contractor plant is on site. The contractor may decrease his unit price and transfer the difference to its MDM lump sum item. The Corps is then providing "working capital to the dredging contractor." (48)

For the average contractor, the inaccuracies of the payment system are accepted as a normal course of events and are dealt with by adjusting his bid. The likelihood of overpayment of MDM expenses suggests that greater investigation and/or modified procedures are called for. The MDM estimating process could be improved without generating a single mandatory system that would disallow the acknowledgement of regional or job related factors. Reimbursing only proven contractor costs would clearly minimize the problem but would not aid the Corps in estimating the value of future contracts. It would, however, deal positively with the dilemma of paying the contractor twice for mobilization. Increased supervision and the analysis of submitted costs could prove difficult since MDM costs are by nature ill defined. The significance of the dollar sums involved does, however, dictate a need to review the wisdom of the current system.

3.4 BROADER MANAGEMENT PERSPECTIVES

The management of individual dredging projects is dictated to a great measure by the imprecision of both dredging itself and estimating the process. Until new methodologies or hardware are introduced, the current state of affairs will continue. The managerial problem can be viewed though in a larger sense if the perspective is changed from a site specific to a regional or national viewpoint. The issues then tend to incorporate such questions as how deep should channels actually be and what are the priorities for maintenance dredging among a series of possible channels? These questions are beginning to be asked by various researchers and federal agencies. They ultimately involve the question of optimizing the mix of increased dredging costs versus decreased transportation costs as shown in Figure 2 below.

Figure 3.2: Optimizing Total Cost Curve



The depths of federally maintained navigable waterways is determined by Congress. Once determined, the authorized depths are rarely changed. It is suggested that many authorized channel depths do not take into account the recent rise in the value of transported goods and, thus, the benefits portion of the cost/benefit equation may be significantly altered. The existing authorized channel depths reflect the transportation costs and vessel drafts in previous years and may not coincide with what may be called the optimum channel depth. Since larger vessels can carry greater volumes of goods, the unit transportation costs and final costs to consumers is demonstrably lower. Increased channel depths required to accommodate these larger vessels obviously dictate greater dredging costs. The optimum mix of these variables appears to be, in one instance at least, to dredge to whatever depths are required to allow access for these larger vessels. (49) This is a reflection of the fact that the majority of waterborne cargo is energy related; crude oil and petroleum distillates. The increasing value of these commodities has skewed the historical cost/benefit ratio analysis of most navigable waterways.

The case can be made for the reanalysis of existing federal channel depths through the use of computer models to ascertain which of these should be deepened (or decreased) to more closely arrive at the point of minimum total costs. With increasing energy costs, the long run benefits of this approach are evident. Although this has been suggested before,

the urgency is increasing. Such a review is presently underway and is called the National Waterways Study. The goal of this program, being conducted by the Institute for Water Resources, U.S. Army Corps of Engineers, "is to develop a comprehensive framework for future decision making about the use of the U.S. waterways for transportation purposes." (50)

Total dredging costs could be decreased by viewing the system from a regional standpoint. The question of MDM costs could be addressed by grouping a series of dredging projects within a region and awarding the package to one contractor. MDM costs would be lowered as a direct result, plus, contractor dredge plant utilization rates would increase. This would allow lower unit prices since contractor plant would be operational a greater percentage of the construction season. This longer period of productivity would lower risk and increase the amortization period for dredge plant depreciation. Where the technique is presently in effect, it could be expanded to include projects lying at the limits of District jurisdictional boundaries. Externally imposed scheduling constraints and the possible increase in total time required for project completion are problems that should not be underestimated if this technique is applied.

3.5 CONCLUSIONS

The project planning and management of dredging work is atypical from most other construction disciplines. The inability to accurately forecast and monitor actual dredged volumes has resulted in a presumed level of inaccuracy that can only be overcome by the introduction of new hardware. The regionally divergent methods for estimating MDM costs have resulted in a system that may overcompensate contractors for actual costs incurred. Although there are many other areas of dredge project management that deserve further refinement, the costs that result from these two factors could be brought closer in line with reality by modifying current techniques or conventions.

Dredging is becoming an increasingly expensive process with unit dredging costs rising annually while total quantities dredged decrease. In most regions of the nation, cost increases have exceeded the annual rate of inflation. To those agencies charged with funding and controlling the process, the problem of cost escalations has traditionally been addressed by increased funding requests to Congress. At some point, this process of paying more while doing less must be reversed. There now exists a significant need to quantify those forces which are causing the escalation of unit prices. It is important to note that there have been very few if any published articles in the literature which examine the problem or suggest solutions. The National Dredging Study, discussed

in Chapter 6, was a major step in understanding the dredging market in America and could form the foundation for this further analysis. The investigatory process should now be extended to determine those areas, whether technological or managerial, which can be improved to induce lower unit costs.

It appears that project management and control techniques can be significantly strengthened through new hardware and the imposition of new Federal regulations which would tighten cost controls. If these improvements are to occur, they must be preceded by detailed cost analysis studies premised on the concept that unit dredging costs can be lowered without necessarily endangering the profit margins of private dredging firms.

4. ADVANCEMENTS IN DREDGING METHODOLOGY

4.1 INTRODUCTION

Dredging operations are normally thought of as being related almost solely to the maintenance or improvement of existing navigable waterways. The majority of dredging does in fact revolve about this central issue primarily because of the immediacy of the problem and its universality. The dredge and its utilization is not, however, constrained to this traditional role. In recent years, the concept of the dredging process has been expanded to address a wider range of potential uses beyond the typical role of channel work. The expansion of dredge into new and challenging areas is indicative of the inherent flexibility of the process itself. The ability to move submerged deposits is sufficiently broad to allow its application to areas seemingly beyond the capacity of the equipment. The apparent role of the dredge is thus undergoing a fundamental re-examination. What follows is a brief review of some of the new applications of dredges to old problems.

4.2 BEACH NOURISHMENT TECHNIQUES

4.2.1 Problem Scope. The coastline of the United States has been a natural resource that has been exploited for economic and social purposes since the founding of the nation. The total shoreline length of the United States including Alaska, Puerto Rico, Virgin Islands and the Great Lakes totals approximately 84,300 miles. (51) The usage of this great resource is indicative of the fact that a significant percentage of this total is regarded as an exploitable commodity leading to encroachment of civilization ever closer to the coastlines. This shift of population towards the coasts has resulted in a greater awareness of a slow, almost imperceptible process: beach erosion.

Figure 4.1: Usage of the National Seashore (52)

USE	U.S. excluding Alaska Miles	%	Alaska Miles	%	U.S. plus Alaska Miles	%
Recreation, Public	3,400	9	-	-	3,400	4
Recreation, Private	5,800	16	-	-	5,800	7
Non-recreation	5,900	16	300	1	6,200	7
undeveloped	21,800	59	47,100	99	68,900	82
	36,900	100	47,400	100	84,300	100

Figure 4.1 depicts the various uses of the total national seashore. Fully 41% of the seashore of the contiguous United States has been put to some use by the nation. The shore,

however, does not present a uniform condition along its entire length. Figure 4.2 illustrates this fact by differentiating the total coastline into beach and nonbeach regimes. As can be seen, the extent of the beach environments is in the minority and reflects the limited nature of this resource.

Figure 4.2: Characteristics of the National Seashore (53)

	U.S. excluding Alaska	
Shoreline Characteristic	Miles	%
With beach	12,200	33
Without beach	24,700	67
	36,900	100

The relative delicacy of the beaches that constitute the third of the contiguous coastline is reflected by the fact that "approximately 42% (15,400 miles) of this shoreline undergoes erosion, with about 8% (2,600 miles) eroding at such a rate as to be termed critical." (54)

The erosion of a beach is primarily a result of wave action and littoral (longitudinal) current transport of beach and submerged sediments. The exact mechanics of the process are undergoing greater analysis since the scope of the problem has been identified. The immediacy of the situation is maximized where the encroachment of man and his structures were built on what appeared to be static beach profiles. With more careful study, these shorelines are seen to be in a state of transition with sediments either accumulating or eroding. The necessity of reversing the erosion process has met with some question as to the wisdom of saving the in-

vestments of those who have, in the eyes of others, unwisely built next to a shifting shoreline. The efficacy of reversing the process is much less of a question to those whose homes or businesses are slowly being surrounded by the sea. Substantial financial investments have been made and justifiably deserve the concern of those able to mitigate the process.

The traditional answer to the problem of beach erosion has been two-fold. Since the situation is essentially transport of sand away from the beach, in many instances the introduction of new deposits trucked from inland has appeared to be the most economical and obvious solution. However, "replacing beach sand from dwindling inland sources has increasingly increased in cost and is, in many instances, environmentally undesirable." (55) It also presupposes a readily available supply of sand within economic haul distances. A second, and presumed to be more effective long term solution, has been a structural answer. The construction of jetties, groins and other permanent structures perpendicular to a beach and extending into the sea were predicated on the belief that these structures would retard the littoral movement of sediments along the beach. While this does in fact occur, a detrimental side effect is induced. Beyond the extent of these structures, littoral drift continues and is increased since up-beach sediments no longer flow into that area. The use of jetties thus imposes a requirement to either extend their use along the full length of a beach or to decide where

to accept erosion at a greater than normal rate. This subjective decision is often a difficult and emotional process. Furthermore, the use of jetties is less than desired in some areas since the aesthetic effects of the structures tend to diminish the natural beauty and thus the financial value of the surrounding property. The traditional solutions are therefore either not wholly applicable or not desirable in many instances. The requirement to mitigate beach erosion has called for new, innovative procedures that could successfully yet economically address the problem.

As may be evident by now, the dredging process' inherent capacity to transport submerged sediments has been recognized as a potential solution. The technique of hydraulically placing sand from the off-shore zone back onto eroding beaches through the use of dredge plant, a process commonly called beach nourishment, has been successfully utilized in a number of instances.

4.2.2 Beach Nourishment Tests. The nourishment of beaches by hydraulic placement of suitable material presupposes the existence of a supply of material nearby the problem beach and of a suitable quality. The availability of this supply was investigated by the Corps of Engineers Coastal Engineering Research Center (CERC). CERC has been conducting "the Inner Continental Shelf Sediment and Structure Survey (ICONS), formerly called the Sand Inventory Program, since the mid-

1960s. The purpose of this survey is to find and delineate offshore deposits of sand suitable for beach restoration and stabilization." (56) Begun in 1964, results to date indicate "the existence of suitable sand deposits between the 15 and 100 foot depth contour within 10 miles of any selected location on the shore. The concentrated sand deposits vary in thickness with some being in excess of 25 feet. Between the concentrated deposits exist a one to two foot layer of sand. This sand layer contains an appreciable percentage of fine sand, whereas most of the concentrated deposits appear to have sand equal to or coarser than materials in the foreshore and beach zone areas." (57)

Once the availability of the sand was established, the Corps of Engineers began a series of tests at selected locations to determine the feasibility of transposting the material back to the beach through the use of Corps dredge plant. The operating environment constrained the selection of dredge plant to those types of equipment capable of operating in open waters where significant wave action is typical. The attributes of hopper dredges was fundamental in their selection for use in this harsh environment. Their ability to dredge sand up to an average depth of 60 feet also allowed them to gain access to a substantial portion of the deposits in the offshore zone.

The first such beach nourishment test was conducted along the Atlantic shore at Sea Girt, New Jersey in the spring of 1966. The site was chosen since "the property

required beach nourishment, was in a typical severe ocean environment, and was near a known offshore sand deposit." (58) The Corps hopper dredge Goethals was chosen for its large hopper capacity (6,422 cubic yards) and its ability to pump out the contents of its hopper once loaded. This first full scale feasibility test of hopper dredge beach nourishment was based upon the concept of tilling the hopper from adjacent sand deposits, and moving the dredge under its own power to a floating barge positioned approximately 2,000 feet offshore. A submerged, one-piece, welded, 28" diameter steel pipe extended from this barge along the sea bottom and up onto the beach. The Goethals attached its discharge line to this pipe and using its onboard pumps, hydraulically moved the sand from its hoppers to the beach. Once empty, the dredge was disconnected, travelled 1½ miles back to the deposit, refilled its hoppers and repeated the process.

The greatest problems encountered during the Sea Girt test were mechanical failures in the connection between the mooring barge and the ocean end of the submerged pipeline. The problems were basically a result of weather since wave action and resultant forces placed on the connections proved excessive to their design. During one non-test period, a severe storm caused the mooring barge to break away from its anchors and it was ultimately forced to the beach. Additional barge anchors and strengthening of the barge/pipeline connection permitted the test to continue once calm weather returned.

The ultimate viability of the concept was proven by the

Sea Girt test. In all, 52 hopper loads totalling 250,093 cubic yards of material were delivered to the beach. However, the total effective pumping time was only 54%; much less than the 70% estimated. The total project cost was $680,170 versus an estimated $700,000. This yielded a unit cost of $2.72 per yard which was above the $2.00 estimated. The higher unit cost was a reflection of the decreased productivity, equipment failures and repairs and higher initial costs for some items of equipment. The unit cost achieved was, however, less than the cost to accomplish the same results if inland sand was transported by truck to the beach.

A second, and slightly altered test, was conducted at Jacksonville, Florida in the spring of 1974. The Goethals was again utilized along with a floating barge to hydraulically transport sand to a severely eroded beach. A significant difference in this test was the siting of the barge adjacent to a stone jetty from which the discharge pipe ran along the beach. The reduced wave action resulted in a much more stable pumping condition with reduced mechanical failures. This arrangement also allowed the use of spuds on the mooring barge (reinforced by two anchors) which further enhanced the stability of the system as a whole. The 8,000 foot long pipeline, however, approached the pumping capacity of the dredge and resulted in clogging of the line on some occasions.

As a result of the lessons learned at Sea Girt and the less severe site conditions, the Jacksonville test was considered a success. "During the period March 25 to May 1,

one hundred twenty five hopper loads of material totalling 400,170 cubic yards were delivered to the beach...through a pipeline with a 28" diameter." (59) Based on an actual project cost of $919,160, a unit cost of $2,30 resulted. This was in close agreement to the $2.24 per yard that was estimated. The effective time was increased to 83.2% which was a significant improvement over Sea Girt. Again, the unit cost incurred was less than alternate beach nourishment procedures.

As the feasibility of hopper dredge beach nourishment operations was being proven, the application of the process won greater acceptability. An example of this growing attitude was evident in the third field test conducted at Virginia Beach, Virginia in the fall of 1974. This major recreation beach fronting on the Atlantic Ocean had been experiencing considerable annual erosion which was being partially overcome through the use of small cutter head dredges pumping material from surrounding estuaries to the beach on an average of 150,000 cubic yards per year. As a result of new environmental limitations, this procedure was halted in early 1974. Unusually severe erosion in the preceding year heightened the need for nourishment by some alternate technique. A request to the Corps of Engineers resulted in the third major field test of hopper dredges in beach nourishment work.

The conditions that existed at the Virginia Beach test were similar to Sea Girt in that the mooring barge was stationed in open seas. It incorporated a much longer pipeline (26,500 to 28,000 feet) which was to be connected to two land

based booster stations to allow such extreme pumping distances. Limitations on time and funds forced a change in plans with the final pipeline being submerged, 28 inches in diameter and 4,690 feet long. Pumped material was stockpiled at the end of the pipeline and was trucked to the eroding beach.

In the test, a DeLong Pier (80' x 300') was utilized as a fixed berthing position for the Goethals. The pier is a floating barge equipped with 10 spuds each six feet in diameter and 78 feet in length. By extending the spuds, the pier rises from the water and forms a stable mooring dock. Alongside the pier, a second barge was positioned and the submerged pipeline was connected as in previous tests. Pumping operations subsequently began on October 6, 1974.

During the ensuing weeks, a series of severe storms occurred but did not substantially hinder the operation. Wind gusts up to 30 miles per hour and seas to 6 feet were recorded while pumping continued. Final transported quantities totalled 572,414 cubic yards or 174 hopper loads. The estimated cost of $1,230,000 was exceeded and amounted to a final price of $1,353,816. "This resulted in an actual unit cost per cubic yard of $2.37 for 572,414 cubic yards delivered to the beach and $3.00 for the 452,000 cubic yards of material retained above the mean high water level." (60) The effective time reached 86% in spite of the severe weather conditions. Results indicated that operations could continue as long as wave heights did not exceed 6 feet. The Virginia Beach test thus further refined the beach nourishment technique by

illustrating the need for rigidity of the berthing system when severe sea conditions are expected.

As a result of the three tests, beach nourishment through the use of direct pumpout hopper dredges has been accepted as an economical and reliable technique. The largest beach nourishment project ever attempted is now in progress at Miami Beach, Florida. Under the supervision of the Jacksonville District Engineer Office, 10.5 miles of new beach will be created with an average width of 250 feet. Scheduled for completion in 1981, the estimated contract value of $64 million reflects the immensity of the undertaking. The success of the project could breathe new life into the tourist trade which has diminished in pace with the withering beaches.

While the technique has been proven in its ability to reverse the effects of beach erosion, it has become a controversial topic in many circles. The technique must be regarded as restorative and temporary in nature since the forces of nature have not been appreciably altered or diminished. It is therefore a maintenance procedure of limited duration. To some, it is viewed as legitimitizing existing beach construction or even as an inducement that might spur growth into areas considered to be unstable in the past. In addition, complaints are based on the belief that, "None of these projects has ever been permanent. All they do is buy a few years at an exorbitant cost." (61) While this may be partially true, the alternative of inaction and resultant severe damage to existing facilities appears to be less than

pragmatic or justifiable. If growth along sensitive and shifting beach zones is to be prevented, land use planning and improved zoning controls must be invoked.

4.3 ALTERNATE APPLICATIONS OF DREDGING

The list of potential uses for the technology of dredging is growing in length. Reclamation of sediments for use as construction materials is a time proven industry. Similarly, dredging is an economical and efficient procedure for submerged mining of increasingly valuable resources such as tin, gold and diamonds. Mineral rich nodules found in deep sea environments are recognized as prime candidates for recovery through the application of modified dredging techniques. These applications are reported elsewhere and constitute new horizons for the dredging industry. Jurisdictional disputes are currently inhibiting the exploitation of these new deposits. However, the capacity to recover them has been proven in limited field tests.

The dredge's ability to deepen existing reservoirs and thus increase storm runoff and potable water storage is an additional beneficial application of the process. As reported by Roberts (62), small transportable dredges are in use which can remove silt from existing water supply reservoirs. These dredges use a horizontal auger system on a hydraulically operated boom which forces material to a central intake pipe.

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DREDGING: ENGINEERING AND MANAGEMENT CONSIDERATIONS.(U)

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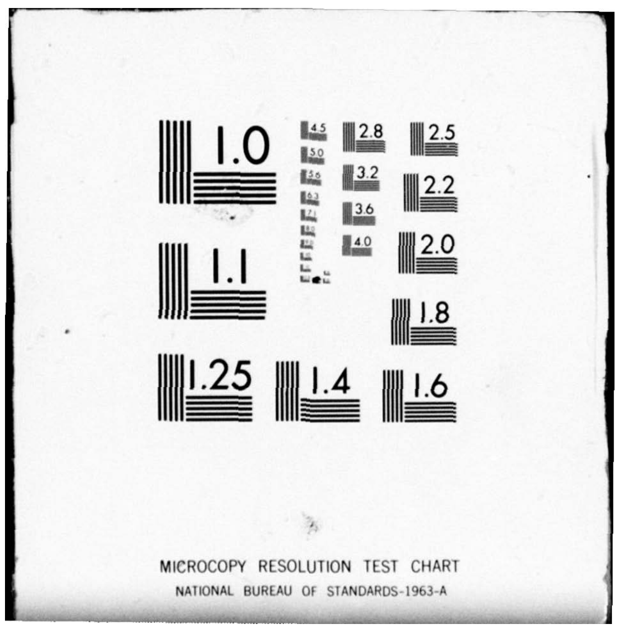
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Material is then transported through discharge lines to a nearby settling basin. "An Illinois community (population 1,010), which has a 26 acre (110,500m^2) water supply lake that had lost nearly half of its original volume, used this type of dredge to remove 200,000 cubic yards of sediment. This was accomplished during the first two years at a cost of 28 cents per cubic yard." (63) This type of operation can create a new landfill or the material can be used to rejuvenate existing nearby farmland. "A similar spoil area used for another Illinois lake dredging project produced 45 bushels per acre of winter wheat without the addition of fertilizer. Such sediments are generally rich in nitrates, phosphorus and potash because they come from heavily fertilized watersheds." (64)

The application of dredging technology to alternative problems is a topic of research presently under review by the Corps of Engineers Waterways Experiment Station, WES. While initial studies are just beginning, the likelihood of establishing new and innovative applications for dredging and expanding the efficiency of current operations are both high. Improved coordination with European nations whose indigenous dredging industries are among the most modern, is a fundamental requirement in this and every other dredging research and development program.

5. ENVIRONMENTAL ASPECTS OF DREDGING

5.1 INTRODUCTION

The conduct of dredging operations in America over the past decades was a relatively systematic and non-controversial topic. Rivers and harbors silted up and dredges periodically reversed the situation. The tone of the process can be regarded as mainly "business as usual" during the majority of the twentieth century. This attitude was fundamentally altered in the late 60s and early 70s, as were many other segments of American life, by a new and vigorous national awareness of environmental issues. For the first time, the dredge operator was being required to justify his actions within a totally new set of criteria: the environmental impacts of his operations.

While the environmental movement has had a demonstrable effect on many, if not all aspects of the American construction industry, the dredging field has been subjected to unusually severe impacts as a result of environmental concerns. Few other construction industries have been forced to reconsider, and in many instances appreciably alter, the way they accomplish their missions. This great effect on dredging reflects another fundamental characteristic of the field not shared by many other disciplines. Dredgers have

moved tremendous quantities of material over the years; material that was considered more or less benign in its characteristics. With the environmental movement, these dredged volumes became, in the minds of many, harmful to the environment at best and, to others, poisonous wastes. This unavoidable production of an environmentally suspect substance forced dredging to be affected by the environmental debate to a degree unparalleled by many other processes.

5.2 CHARACTERISTICS OF DREDGED MATERIAL

The effect of dredged material (DM) on the environment was not of great interest until recent years. However, the engineering aspects of DM had been fairly well quantified since DM could be used in some instances as a useful construction material. Tests have been conducted in order to define the peculiarities of DM in regards to its pumpability and use as a construction material.

The most decisive characteristic of DM is its grain size distribution. Since most DM arises from sedimentation of particles in suspension, the material is largely silt and clays. Appendix E shows the grain size distribution of bottom sediments as reported from a series of Corps of Engineer District Offices.

The submicron portion of these samples ranged from

10%-40% by weight. This does not realistically conform to the conditions during dredging operations since the grain size distributions in Appendix 4-1 result from ASTM procedures that dictate the use of a dispersing agent. The use of this agent breaks down flocculated clay particles which would not occur during dredging operations. "For the materials tested, particles smaller than 10 are found to constitute 15%-35% of the sample when no dispersing agent was used; submicron particles constitute 3-15% of the sample tested in its natural state and 7-40% of a dispersed sample." (65) The grain size distributions in Appendix E reflect in situ conditions which would correlate most closely with maintenance dredging but may also be found in new work projects where dredging depths do not pass through stratified layers of differing materials.

Further and more detailed engineering analysis of dredged material has been conducted and reported by various agencies. One such study conducted by Krizek and Salem (66) analyzed various factors of DM after deposition in diked disposal areas near Toledo, Ohio. One conclusion of their report states, "Unless appropriate dewatering procedures are employed, landfills composed of hydraulically placed maintenance dredgings will remain soft and weak for long periods of time, thereby restricting the potential usefulness of the landfill." (67) This obvious result of the fine particle characteristics and extreme water content inherent to DM has resulted in the historical characterization of DM as a waste product of

dredging. (Notable exceptions exist where dredging is done solely for the reclamation of material for use as a construction material. This is, however, a minor element of the dredging industry.) This attitude towards DM as a largely useless substance, led to disposal techniques that involved the least cost. Typically, the material was moved the shortest distance possible and disposed of with little regard to the impact of the material on its new location. Open water dumping beyond the coastal zone became a common method of DM disposal. This technique ultimately led to the enactment of a totally new series of laws and regulations governing the field of dredging.

5.3 ENVIRONMENTAL LAWS AND REGULATIONS AFFECTING DREDGING OPERATIONS

5.3.1 Jensen Criteria. The majority of the dredging work accomplished in the Great Lakes region has relied upon open water disposal of DM. In the late 1960s, environmental concerns over this technique grew after a series of studies were conducted by personnel of the Federal Water Pollution Control Administration. In 1967-1968, these studies analyzed the pollution levels of a series of navigable Great Lakes harbors through the use of bulk sediment chemical analysis and by reviewing the biological and physical status both of polluted and unpolluted harbors in the region. This series of studies generated a subjective categorization of pollution

levels based on percentages of certain chemical constituents. This allowed others to put a label for the first time on just what areas were or were not polluted.

As the environmental considerations of dredging increased through the on-going national debate, the EPA adopted the findings of the Great Lakes study and issued them as a series of guidelines which came to be known as the Jensen Criteria. This guideline, reproduced in Appendix F, stated that "dredged bottom sediments could be classified as polluted if the bulk concentration (on a dry weight basis) of any of seven chemical constituents exceeded the following limits: volatile solids, 6%; chemical oxygen demand, 5%; Kjeldahl nitrogen, .1%; oil and grease, .15%; lead, .005%; mercury, .0001%; and zinc, .005%." (68) These very stringent limits were widely used to determine whether or not bottom sediments were polluted. If they were defined as polluted from the Jensen Criteria they were not to be disposed of in open waters, but would have to be either confined in diked disposal areas or dumped in deep water (100 fathoms deep or more).

The imposition of the Jensen Criteria almost immediately halted a large proportion of scheduled maintenance dredging work, especially in the Great Lakes area. Since deepwater disposal was a difficult proposition in the region, upland disposal of the material in diked areas was seen as the only solution to meeting the requirements of the Jensen Criteria. With this solution came the requirement to acquire sufficient

land on which to build the new diked disposal areas. The Rivers and Harbors Act of 1970 (Public Law 91-611) authorized the Corps to provide confined areas for the disposal of polluted DM for a period not to exceed 10 years. The Corps then estimated that 75 "navigation projects on the Great Lakes (out of 115) would require confined disposal of dredged material." (69) The cost for these diked disposal areas was estimated to be upwards of $240 million. (70) This same amount of money "would pay for 25 years of open water disposal in the Great Lakes." (71) The ultimate nationwide costs would have been without comparison since in 1972 the Corps of Engineers Waterways Experiment Station (WES) estimated that fully "31% of average annual volume in Corps maintenance projects was polluted" according to the Jensen Criteria. (72)

The wide application of the Jensen Criteria was spurred on due to the passage of the National Environmental Policy Act (NEPA, Public Law 91-190) signed into law on 1 January, 1970. NEPA required that agencies proposing work utilizing federal funds must prepare a detailed report referred to as EIS (Environmental Impact Statement) which would analyze the proposed work in terms of:

1. the environmental impact of the proposed action,
2. any adverse environmental effects which cannot be avoided should the proposal be implemented,
3. alternatives to the proposed action,
4. the relationship between short term uses of man's environment and the maintenance and enhancement of long-term productivity, and

5. any irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented. (73)

Since the Jensen Criteria was the only extant quantitative guideline, it found greater use as a result of the requirements of NEPA. This resulted in a wide review of proposed and active projects. As of January 1975, "some 249 studies, projects or operations were modified, delayed or reduced in scope for ecological, environmental, aesthetic, historical or sociological reasons. Thirty three studies were completely halted. Of the 249 major changes, 75 river and harbor dredging projects required modification." (74)

The Jensen Criteria had precipitated a monumental impact upon the dredging process. Serious debate questioned whether the Jensen Criteria accurately reflected the impact of disposal of polluted DM on the environment. The Jensen Criteria did not address the pollution level of the receiving waters, nor did it consider the marked differences between fresh and salt water environments. It also made no distinction between estuarine or deep ocean waters. A major point of disagreement was over the use of the bulk sediment test in which a sample of proposed dredged material is subjected to an acid bath and is transformed totally into a liquid. This process releases everything into the solution; even to the point of disrupting the crystalline structure of solids in the sample. The test converts clay particles into their metal constituents thus producing what many considered

spurious results. The severity of the test coupled with the fact that it did not simulate the dredging or deposition process, was a major argument by those who sought the repeal of the Jensen Criteria.

Congress had already acknowledged the lack of scientific knowledge concerning the environmental effects of DM disposal. PL 91-611 had authorized a 5 year, $30 million research program to quantitatively determine the effects of DM. This program, known as the Dredged Material Research Program (DMRP) was assigned to WES in 1971 and was finally completed in December 1978. (The results of DMRP are reviewed later in this chapter.)

As the DMRP was just beginning, the Jensen Criteria debate continued. Congress responded in 1972 through passage of PL 92-500, the Federal Water Pollution Control Act Amendments of 1972, and PL 92-532, the Marine Protection Research and Sanctuaries Act, commonly called the Ocean Dumping Act. These laws replaced the Jensen Criteria and directed the Corps of Engineers, working in concert with the EPA, to generate new guidelines for the dumping of dredged material in inland and open waters respectively.

5.3.2 Enactment of Public Law 92-532. The Marine Protection, Research and Sanctuaries Act of 1972 (Ocean Dumping Act) was enacted into law on 18 October, 1972. The final ocean dumping guidelines which implemented the law were published

in the Federal Register in Vol. 42, No. 7, 11 January, 1977 and are reproduced in Appendix G. The Ocean Dumping Act is applicable only to ocean waters which "means those waters of the open seas lying seaward of the baseline from which the territorial sea is measured, as provided for in the Convention on the Territorial Sea and the Contiguous Zone (15 UST 1606, TIAS 5639)." (75)

The Ocean Dumping Act came in response to the concern that unrestricted ocean dumping of dredged material could harm the environment by "the impairment of photosynthesis as a result of decreased light transmission, and the covering and resultant alteration of benthic (bottom dwelling) communities. Benthic effects include not only gross damage, such as habitat destruction and smothering, but may encompass more subtle long term effects, such as inhibition of locomotion, alteration of feeding habits, disruption of prey-predator relationships (e.g. by modifying natural cover), and interference with reproduction by destroying bottom laid eggs. Resettlement of affected areas may occur slowly even after dredged material disposal has ended." (76) The requirements of the law are very specific in nature and rely heavily on bioassays of potential disposal sites. In one such test, referred to as the solid phase bioassay, at least three representative species of benthic organisms are introduced into a sample of sediment from the potential dredging site. Following carefully specified procedures to include control groups, the mortality rate of the species is determined after

10 days exposure to the DM sample. "If the difference in mean survival between animals in the control and test sediments is statistically significant and greater than 10 percent,... the LPC (Limiting Permissable Concentration) would be exceeded, and the bioassay would have shown the material to have a real potential for causing environmentally unacceptable impacts on benthic organisms." (77)

The impact on the potential disposal site is also analyzed through a series of similar tests. Among these are the Bioaccumulation Potential Test (which measures the capacity of organisms to store and accumulate DM contaminants over time), Liquid Phase Chemical Analysis, Liquid Phase and Suspended Particulate Phase Animal Bioassays, and Liquid Phase and Suspended Particulate Phase Phytoplankton Bioassays. The exact manner in which these extensive tests are to be accomplished is presented in an implementation manual generated by the Corps and EPA. Once the tests are completed, the regional EPA administrator and the local District Engineer review the results. If any disagreement remains, the EPA official has the final decision and may override the Corps and refuse to issue a dumping permit.

The major difference between the Ocean Dumping Act and the Jensen Criteria involves a philosophical divergence in how ultimate disposal effects are forecasted. The Ocean Dumping Act relies upon experimentally reproducing the actual effects of proposed DM on benthic species residing in the dispoasl site versus relying on a subjectively arrived at

set of maximum pollutant levels. The final effect of the law has been a general easing of controls on ocean dumping by the use of these empirical tests. The process, although somewhat less stringent than that under the Jensen Criteria nonetheless involves considerable time, effort and expertise in order to meet the Ocean Dumping Act requirements.

5.3.3 Enactment of Public Law 92-500. Under the Federal Water Pollution Control Act Amendments (FWPCA) of 1972, "a permit system, initially to be administered by the Environmental Protection Agency then transferred to the States, was developed to prohibit the discharge of pollutants into navigable waters." (78) The FWPCA governs, among other things, dredging operations inland from the baseline of the territorial sea; i.e. lakes, rivers and harbors. FWPCA has been a focal point in the environmental debate and has greatly impacted on both the administrative actions of the Corps and dredging as a whole.

The FWPCA has followed a circuitous route through the courts. Primary among the issues was the manner in which the National Pollution Elimination Discharge System (NPDES) was to be organized and implemented. This permit program involved the Corps since Section 404(a) of FWPCA stated, "The Secretary of the Army, acting through the Chief of Engineers, may issue permits, after notice and opportunity for public hearings for the discharge of dredged or fill

material into navigable waters at specified disposal sites." (79) The crux of the disagreement was over the definition of the term navigable waters. The Natural Resources Defense Council, Inc.,brought suit in the District Court of the District of Columbia against the Secretary of the Army and Chief of the Corps of Engineers alleging that they had "unlawfully sought to restrict their regulatory jurisdiction over the discharge of dredged or fill materials...by limiting their definition of jurisdiction to the traditional interpretation of navigable waters." (80) The Court agreed on March 27, 1975 and directed the Corps to redefine its authority in the permit process.

After continued Congressional debate, the final regulations defined navigable waters

> to mean the waters of the United States including the territorial seas with respect to the disposal of fill material and included:
> 1. coastal waters subject to the ebb and flow of the tides,
> 2. coastal wetlands, mudflats, swamps and similar areas contiguous or adjacent to other navigable waters 'periodically inundated' areas are included,
> 3. navigable waters to their headwaters, laterally to their ordinary high water mark,
> 4. artificially created waters used for recreation,
> 5. all tributaries of navigable waters,
> 6. freshwater wetlands contiguous or adjacent to navigable waters,
> 7. waters administratively determined to necessitate regulation for the purpose of water quality. (61)

The impact of this decision on the Corps permits program

under Section 404 was severe. The Corps was now required to exercise authority over "3.5 million miles of rivers and adjacent wetlands and other aquatic areas as compared to some 50,000 miles previously." (82) Various unsuccessful bills were introduced attempting to restore Corps permit jurisdiction to conform to the historical definition of navigable waters. The present definition is ill defined and remains a changing commodity. The attitude of the Corps is typified by the remarks of Colonel Robert B. Hughes in an article published in the November 1976 issue of World Dredging and Marine Construction where he said, "It should go without saying that we support the Administration's position; however, between the two bills in Congress, we're neutral. We've got to be! Look at it this way. If we strongly campaign for extended Corps jurisdiction, half of the public will view us as grasping for power--we're not. But at the same time, if we openly reject the idea of expanded Corps jurisdiction, the other half of the public will view us as being unconcerned with protecting America's wetlands--this certainly is not the case." (83)

The permit problem is further exacerbated by the wording of FWPCA which states that "federal agencies shall comply with state requirements respecting control and abatement of pollution." (84) Corps dredging operations must now adhere to state water quality standards in order to gain a dumping permit. Since state criteria vary widely, the permit process varies with locale.

The final pollution criteria for the implementation of FWPCA has not yet been published. Interim Final Guidelines were published in the Federal Register on 18 September, 1979 and are included as Appendix H. The format and permit granting procedures of this act are similar to the Ocean Dumping Act in many instances. However, where PL 92-532 mandatorily requires the use of bioassay tests, FWPCA states that these tests are discretionary although some tests must be done. The regional EPA administrator and local District Engineer now confer on the tests to be accomplished and jointly review the results. In most instances, bioassay and elutriate tests are conducted. The levels of control involved in the permit process continue to elongate the process. "In spite of the fact that the use of such tests is discretionary in the case of dumping materials resulting from maintenance dredging inside the baseline, the application must obtain not only a permit, but also a water quality certificate from the state into whose waters the material is to be dumped. Thus, even if a sample of dredged material were to pass a series of elutriate tests and bioassays, but did not conform to a states water quality standards, the applicant would be prohibited from discharging the material." (85)

5.4 THE DREDGED MATERIAL RESEARCH PROGRAM (DMRP)

5.4.1 Program Development. Throughout the legislative and

public controversy surrounding the environmental impact of dredged material disposal, an underlying factor has contributed to the lack of agreement. This element is the lack of quantified and scienfifically derived and verified methodologies that would define the impact of DM on the environment. To fill this void, the 1970 Rivers and Harbors Act PL 91-611, Section 123(i), authorized a 5 year, $30 million research program to finally shed some scientific light on the debate that raged at that time. The Corps of Engineers Waterways Experiment Station (WES) was assigned in May 1971 to define and assess the problems and develop the research program. Funding was authorized by the Office of Management and Budget (OMB) in February 1973 after which WES initiated research in March 1973. WES completed the Dredged Material Research Program (DMRP) in March 1978.

The objective of DMRP was "to provide, through research definitive information on the environmental impact of dredging and dredged material disposal operations and to develop technically satisfactory, environmentally compatible, and economically feasible dredging and disposal alternatives, including consideration of dredged material as a manageable resource." (86)

Specific goals of the program were then formulated to meet this objective. These goals were divided into four main groups as follows:

1. Environmental Impacts and Criteria

Development--"establish definitively the effects of open-water, land, and wetland disposal on water quality and organisms,"

2. Habitat Development--"test and evaluate concepts of marsh development and land and water habitat development as environmentally beneficial disposal alternatives,"
3. Disposal Operations-- "Improve and enhance the acceptance of confined land disposal as an alternative and consider regulation of the dredging/disposal operation as an environmental control measure,"
4. Productive Uses--"develop and test concepts for using disposal sites for productive purposes and consider the use of dredged material as a natural resource."

(87)

The DMRP resulted in a prodigious research effort whose final cost was $32.8 million. Sixty seven percent of each dollar was ultimately obligated towards research contracts while the remaining thirty three percent supported the managerial program and related activities. Distribution of the work load was widely based with the majority of the research done by other than federal agencies. Figure 5.1 below depicts the distribution of individual research projects, referred to as work units, among the contributing groups.

Figure 5.1: Distribution of DMRP Work Units (88)

Category	number of work units	total cost
WES or Corps	107	$6,574,900
Contracts with commercial firms	72	5,233,700
Contracts with universities or institutes	77	8,791,700

Category	number of work units	total cost
other Federal agencies	18	1,413,100
	269	$22,013,400

The DMRP's use of external agencies, universities and consultants was accomplished through competitive advertisement of scopes of work and was done to both accelerate the process and "hopefully contributed to its quality and credibility." (89) The DMRP is not one book but rather is a lengthy compilation of:

55 Information Exchange Bulletins

24 Miscellaneous Papers

174 Contract and Technical Reports

4 Annual Reports

1 Public Information Brochure

1 Publication Index and Retrieval System

This impressive collection of data and research findings translates into a series of publications that are specific in nature and address discrete aspects of the entire problem. The intention is then that a reader would utilize those portions of the DMRP that suit his or her purpose. Appendix I is a DMRP listing of all published reports and information on how to receive copies. The most succinct overview of DMRP is Technical Report DS-78-22, "Synthesis of Research Results Executive Overview and Detailed Summary," December, 1978.

The DMRP program was well publicized during its 5 year length with several articles appearing in the literature

explaining its purpose, management and initial results. WES has also attempted to disseminate as much information as possible through a vigorous technology transfer program. The final results of any such extensive and wide ranging program are difficult to compress into a summary without overlooking major research findings or oversimplifying inherently complex issues. What follows then should be viewed as the key results of DMRP which confirm or dispel prevalent beliefs widely held during the mid-70s.

5.4.2 Environmental Impacts and Criteria Development. The results strongly suggested that the physical effects of open water dredged material disposal are with few exceptions more important than chemical or biological effects. "Physical effects include the smothering of a clambed, the disruption of a flow pattern, a change in salinity, or a similar effect." (90) These effects are supposedly infrequent given the adherence to the guidelines of the Section 404 and 103 programs. The environmental effects on the deep ocean were found to be negligible as most critics of the Jensen Criteria predicted. Also, open water disposal of contaminated dredged materials did not appear to generate the short term harmful effects on the receiving water as most had expected. "As long as the geochemical environment is not basically changed most contaminants are not released from the sediment particles to the water." (91) This is a result of sufficient

mixing of small amounts of released contaminants to the large receiving water volume. "Situations where toxic effects could occur would most likely be where pipeline dredges are discharging large volumes of material into very shallow estuarine waters." (92)

A significant result of DMRP was the determination that dredging and disposal related turbidity was primarily a matter of aesthetics rather than biological impact. Most adult organisms whether tested in the laboratory or the field were able to tolerate turbidity levels and durations "far in excess of what dredging and disposal operations produce." (93) The use of turbidity mitigating measures was also investigated. The use of silt curtains or "diapers" was found to be of minor application in most instances and of little or no value where currents exceed 1 knot or where moderate wave conditions exist. The use of flocculents to reduce open water turbidity was also found to be ineffective or impractical in most situations.

The problem of resiliency of benthic organisms was less easily or uniformly predicted. Once beyond the larval stage most benthic organisms appeared to adapt well to their new disposal site environments. This proclivity is maximized if the dredged material to be disposed of matches relatively closely in grain size distribution with the bottom sediments of the proposed site. The worst condition appears to be when hydraulically placed fluid mud or "fluff" covers an area

since this material "is a hostile and alien environment for many organisms." (94)

The treatment of dredged material to reduce transported contaminants was also analyzed and found to be beyond the capacity of existing treatment systems. Reoxygenation of hydraulically dredged material to overcome oxygen sag was found to be operationally and economically practical.

The effects of DM on the receiving water column over short and long periods is much more limited in extent than many had feared. Although some contaminants were released in the descent phase, toxic levels were not reached except in areas of poor mixing. Long term release of pollutants from deposited DM occurred only in extremely small amounts (sub parts per billion). It thus appears that long term uptake of pollutants into the water system is less than many believed. The long term uptake of pollutants by benthic organisms is not as clearly predictable. Selected disposal sites will be monitored for three more years to determine the effects of low toxicity levels over a protracted time period. (Figure 5.2) This three year monitoring program should confirm or disprove the present indications that long term exposure to contaminants in DM are not substantially ingested into the tissues of benthic organisms. These findings are solely generalizations since different species uptake contaminants at different rates and to differing degrees. The problem does not seem to be as universally bad as initially was believed.

5.4.3 Habitat Development. This phase of DMRP focused on the productive uses of DM in creating habitats that could successfully support various forms of wildlife; a benefit of some disposal techniques that had been accidentally discovered in the past. This phase attempted to determine the natural processes within these regimes and to maximize them. It was found for example, that certain forms of grasses could recover more successfully than initially believed even when covered by up to 9 inches of DM. This finding can help to choose between wetland areas for possible use as disposal sites.

The problem of contaminant uptake by disposal site vegetation was also investigated. The results indicated that different species incorporated different levels at different rates. The predictive nature of the problem was relatively imprecise as was the question of how much uptake was harmful. Results did indicate that uptake did not occur as rapidly or result in as great a mortality rate as commonly believed.

The creation of marshes and islands through controlled disposal operations was also determined to be both ecologically sound and relatively easy to accomplish. The ability to restore and/or extend marshes that had been earlier destroyed was widely accepted by environmentalists as a beneficial use of dredged material. Many of these man made islands and marshes now support thriving colonies of wildlife whose natural habitats have been rapidly receding. The cost of

these techniques was found to be competitive with most other disposal methods but are constrained to areas of minimal tide and wave action. Their construction also requires a greater degree of accuracy and control by the dredge operator in order to meet the more precise spatial requirements. The ability to create islands and to extend marshes has brought with it a dilemma in that competing interests, wildlife conservationists and fishermen, differ in their view of the wisdom of island creation. A case by case compromise is therefore required. In addition, a widespread belief was that once an island was created, it could not be used again as a disposal site or the wildlife that had settled would be destroyed. "This is not true! In fact, studies showed that unless natural vegetational successional patterns are occasionally interrupted, the islands will lose their wildlife value. The most practical way of providing the needed interruption is by depositing a new layer of material." (95)

5.4.4 Disposal Operations. The third area of the DMRP reviewed the problems associated with diked disposal operations. Whereas this technique was viewed as the most environmentally sound method of DM disposal, retaining the material away from the rest of the environment, it was shown that this technique was not problem free. The major factor involves the contaminant levels of the effluent that flows

from the diked areas. Since the material being placed is a water-solid mixture, the majority of the solids are deposited in the diked area, but, if improperly designed, the effluent can contain significant levels of contaminants which are primarily carried by silts and clays in the material. DMRP formulated specific design criteria for future diked disposal areas so that sufficient retention time will allow the majority of the fines to settle out. Previous dike designs revolved around "rules of thumb" that frequently were based on criteria that was untested until after construction. The use of flocculents and coagulants can also effectively treat effluent to minimize the release of contaminants to adjoining waters.

The problem of initially acquiring land for disposal sites and methods to extend the life of existing ones was also a topic of DMRP. The ability to increase capacity of existing sites by either raising dike elevations or reusing contained materials was carefully studied. The ability to dewater the contained material was viewed as an important capability since, "Every cubic yard that can be removed from a containment area and reused, donated or sold off site for any purpose is a cubic yard of new storage capacity gained." (96) Various dewatering techniques were studied to include electro-osmotic dewatering, under drainage systems, vegetational uptake of water and, most successful of all, deep trenching to allow increased evaporation. The use of a Riverine Utility Craft (RUC) was found to be most successful

and cost effective in trenching the containment areas and dewatering the material. (See Figure 5.3) The densification process that results greatly enhances the added storage capacity of existing sites and also improves the engineering aspects of dredged material and their capacity as a construction material. The densified material can be used for elevation of dike walls, creation of haul roads or the ultimate use of the site for light load use (recreation or parking areas).

5.4.5 Productive Uses. The last section of DMRP attempted to modify the notion of dredged material as a relatively useless waste byproduct of dredging. The productive uses of DM in non-wildlife support roles was reviewed and analyzed for their economic viability. Some use of DM as a construction aggregate (other than commercial dredging conducted solely to reclaim DM for that purpose) was researched. It has been used in the manufacture of bricks but the nonuniformity of the material has reduced its application in this field. Economic potential was indicated, however, for the production of shrimp in disposal sites in which, "the disposal site forms the required impoundment and the organic rich dredged material is a periodically renewed source of food for the organisms." (97).

The uses of DM appear to increase in number as distance from the navigable waterway increases. The potential uses of the material then increase markedly into a wide range of

possibilities. The list includes such things as use as capping material in municipal landfills, improvement of agricultural soils, filling of abandoned pit and quarries and strip mine reclamation. Each of these uses are subject to two lingering problems: release of contaminants to ground water and high transportation costs. The leaching of contaminants, especially saline DM deposited in fresh water sites, is a problem that was studied in the laboratory and the field. Indications are that the release of contaminants is a function of the qualities of both the DM and the receiving soil. The question must be addressed on a site specific basis. It should not be forgotten, however, that a great proportion of DM is not contaminated and does not pose any of these problems. The greatest barrier to inland use of DM is the presently excessive transportation costs. In some instances, these costs do not preclude the use of DM. Wide application of DM inland does not appear to be a significant alternative until these costs diminish.

5.4.6 DMRP Summary. The DMRP represents a major investment of time and money in the attempt to illuminate the question of dredging's effect on the environment. The specific results are difficult to reduce to a short synopsis but clearly point to the fact that dredged material is not a universally toxic or useless commodity. The previous pollution standards that relied heavily on set maximum levels of

contaminants are now largely viewed as having been unnecessarily restrictive and did not accurately reflect the true attributes of the material or the processes involved. The resulting consensus is not, however, a simplified approach or de-emphasis of the environmental consequences of dredging. The DMRP acknowledges these impacts and successfully quantifies in many instances their effects. It has also provided a set of reliable methodologies which have since been incorporated into Public Laws so that the delineation of adverse environmental effects can be uniformly accomplished. DMRP results have not, however, been universally accepted and relied upon. This is largely a reflection of the inertia of many groups and individuals who do not part with past conceptions easily. It will take time for the full findings of DMRP to find their way onto the statute books in the form of new or modified regulations.

DMRP's single most important finding then is that DM cannot be treated as a uniform substance nor are disposal techniques able to be ranked according to their environmental acceptability.

> To those concerned with national or regional planning and policy formulation, there are two extremely important fundamental conclusions that can be drawn from the DMRP. The first is that there is no single disposal alternative that presumptively is suitable for a region or a group of projects. Correspondingly, there is no single disposal alternative that presumptively results in impacts of such nature that it can be categorically dismissed from consideration. Put in different terms, there is no inherent effect or characteristic

of an alternative that rules it out of consideration from a technical standpoint prior to specific on site evaluation. This holds true for open water disposal, confined upland disposal, habitat development, or any other alternative." (98)

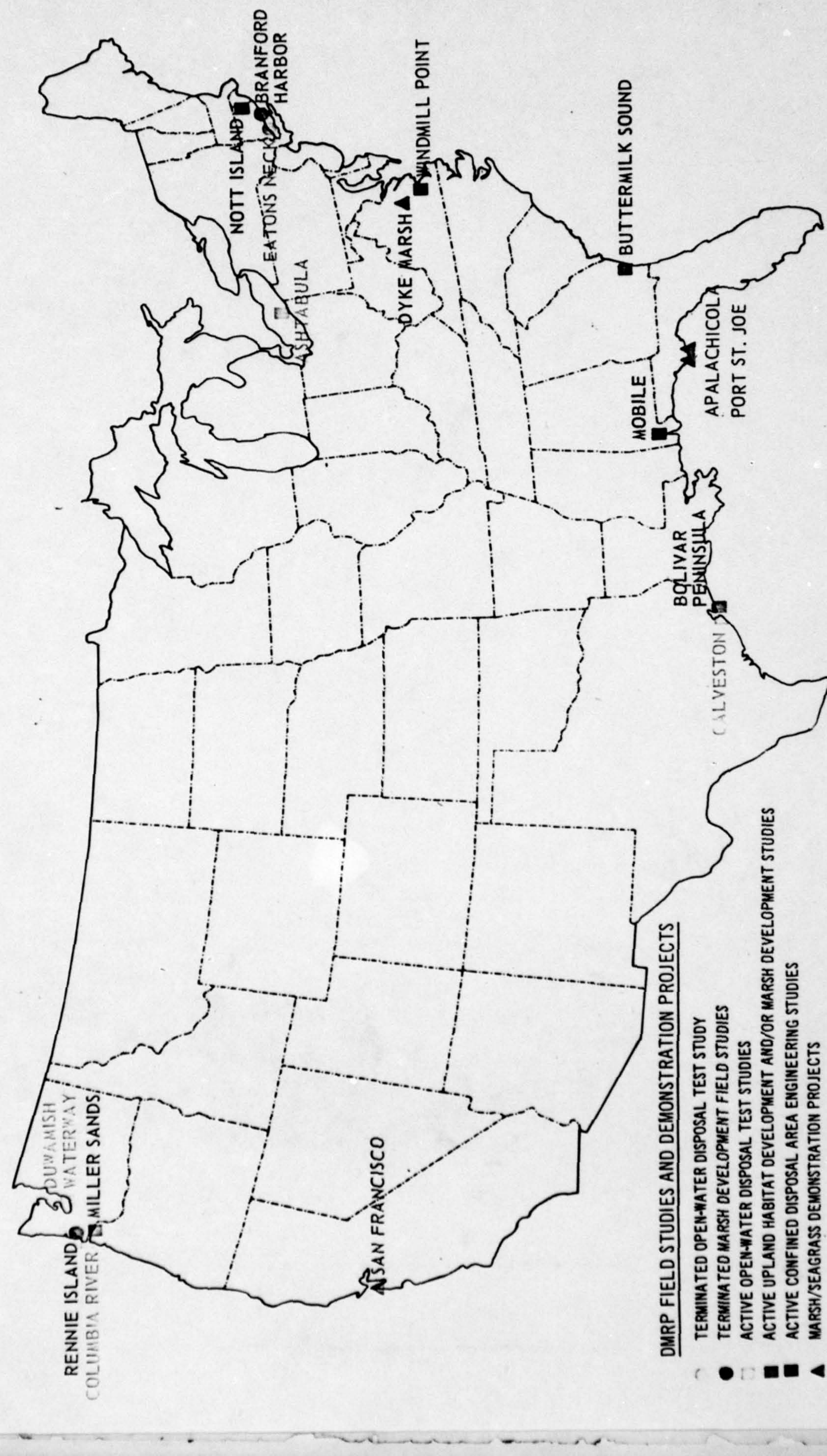

DMRP FIELD STUDIES AND DEMONSTRATION PROJECTS
TERMINATED OPEN-WATER DISPOSAL TEST STUDY
TERMINATED MARSH DEVELOPMENT FIELD STUDIES
ACTIVE OPEN-WATER DISPOSAL TEST STUDIES
ACTIVE UPLAND HABITAT DEVELOPMENT AND/OR MARSH DEVELOPMENT STUDIES
ACTIVE CONFINED DISPOSAL AREA ENGINEERING STUDIES
MARSH/SEAGRASS DEMONSTRATION PROJECTS
RENNIE ISLAND
COLUMBIA RIVER
DUWAMISH WATERWAY
MILLER SANDS
SAN FRANCISCO
GALVESTON
BOLIVAR PENINSULA
MOBILE
APALACHICOLA
PORT ST. JOE
BUTTERMILK SOUND
DYKE MARSH
WINDMILL POINT
ASHTABULA
EATONS NECK
NOTT ISLAND
BRANFORD HARBOR

Figure 5.2

(99)

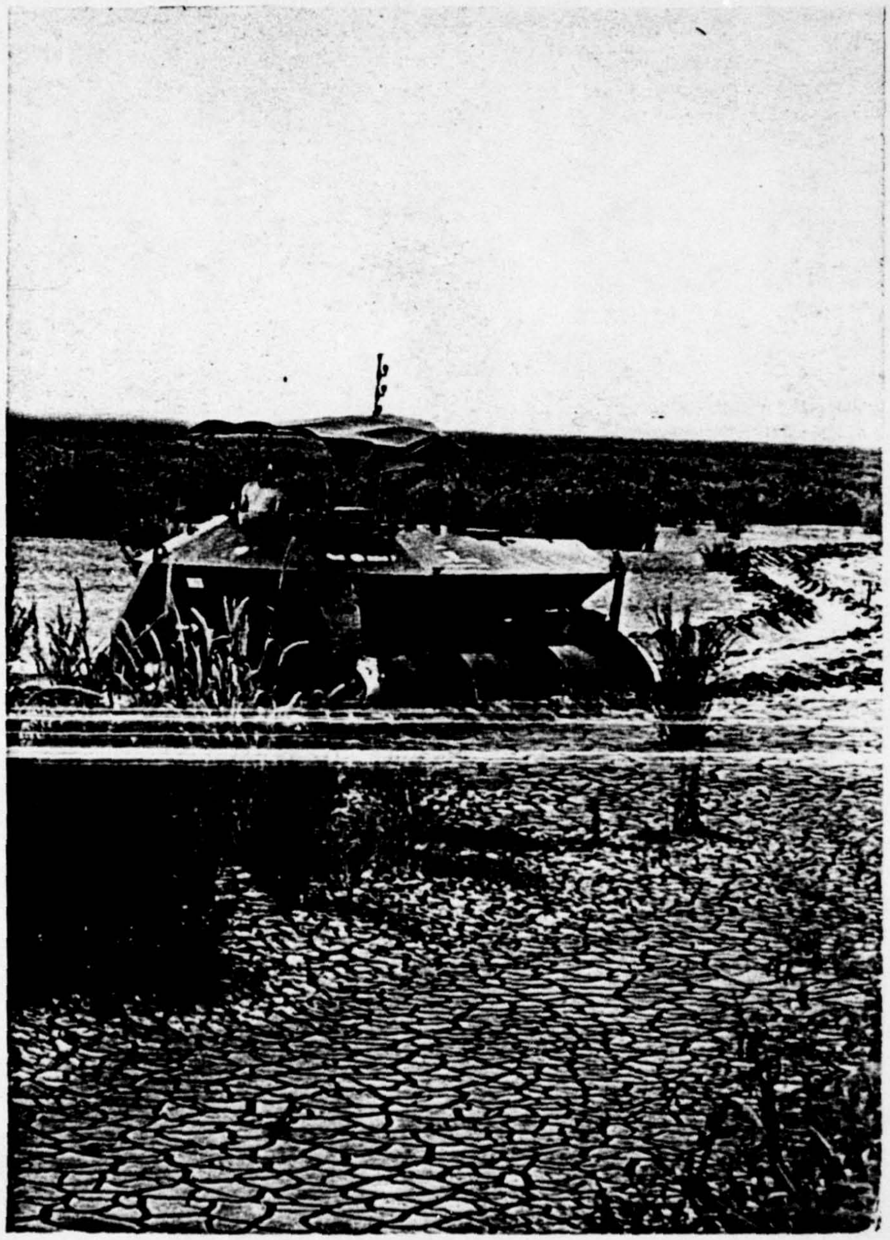


Figure 5.3: Riverine Utility Craft (RUC) Trenching
A Dredged Material Disposal Site (100)

6. DREDGING INDUSTRY PROFILE

6.1 INTRODUCTION

A complete understanding of dredging as practiced in America today, cannot result if it is based solely upon technological or methodological areas. The perspective that would result from this limited viewpoint would by necessity overlook perhaps the most crucial aspect of the entire topic: namely, the real world environment in which the technology is applied. This basic element forms the foundation of the process and must be understood if any valid conclusions are to be reached. The ability to upgrade industry efficiency through modernization is clearly dependent upon the ability of the industry to apply these advancements. Given the fact that dredging has evolved in some areas, the question becomes whether the industry can apply these techniques, and if not, why not. In order to permit this question to be answered, the status of the industry as a whole must be taken into consideration. This chapter will analyze these real world factors.

6.2 ROLE OF THE CORPS OF ENGINEERS

Private dredging firms are in direct competition for public contract work with an agency of the Federal Government which owns and operates its own dredge fleet; the Army Corps of Engineers. No other engineering discipline is in this remarkable position. The impact of this condition can be visualized if one imagines it existed in other areas of public construction. Imagine the consequences if the U.S. Department of Transportation had its own indigenous highway construction assets which actively competed with the private sectorfor public contract work. The profound effects would not be limited to the private firms but would affect other segments of the national economy. This is exactly the situation with regard to American dredging.

The Army Corps of Engineers was formally established pursuant to Congressional authorization in 1802. The need to design and build shore defences and associated projects resulted from the emergence of America as a viable world military power. As the national economy grew, the necessity for Federal involvement in waterborne commerce accelerated. This grew out of the fact that many of the major rivers and bays formed interstate boundaries. Disputes between these competing interests thus flowed to the Federal level. Since the Corps of Engineers was the sole Federal agency with responsibility and capacity for water resource management, its power in this sector of national life grew.

In 1824, Congress assigned the Corps the responsibility for improving and maintaining the navigational channels of the nation's ports, harbors and inland water-ways. In the years that followed, Congressional appropriations were made usually on a bi-annual basis. Although the Federal Government was nominally in charge of the nation's waterways, numerous obstructions were being built in those waterways by private corporations, local communities and States. In order to regulate those activities, the Congress passed amending legislation in the form of the 1899 River and Harbor Act which stated in part:

> That the creation of any obstruction not affirmatively authorized by Congress, to the navigable capacity of any of the waters of the United States is hereby prohibited; and it shall not be lawful to build or commence the building of any wharf, pier, dolphin....or other structures in any port... harbor, canal, navigable river, or other water of the United States...except on plans recommended by the Chief of Engineers and authorized by the Secretary of War; and it shall not be lawful to excavate or fill, or in any manner alter or modify the course, location, condition, or capacity of, any port...harbor, canal...or the channel of any navigable water of the United States, unless the work has been recommended by the Chief of Engineers and authorized by the Secretary of War prior to beginning the same. (101)

The Federal law which governs the development and maintenance of navigable waterways is primarily contained within Title 33 of the U.S. Code. The sections that most directly involve the Corps dredging operations are found in 33 USC 621 through 33 USC 630. The Corps' ability to maintain its own dredge fleet flows from Section 621 which states in part:

> any public work on canals, rivers and harbors adopted by Congress may be prosecuted by direct appropriations, by continuing contracts, or by both direct appropriations and continuing contracts. (102)

This is expanded by Section 622 which allows the Corps to decide whether or not to use its own plant or to employ contracted labor. Section 622 authorizes contracted labor if "reasonable prices can be obtained." (103) This somewhat imprecise terminology was refined to a degree by 33 USC 624 in 1919 which states in part:

> No part of the funds appropriated for works of river and harbor improvements shall be used to pay for any work done by private contract if the contract price is more than 25 per centum in excess of the estimated cost of doing the work by Government plant: Provided, that in estimating the cost of doing the work by Government plant, including the cost of labor and materials, there shall also be taken into account proper charges for depreciation of plant and all supervising and overhead expenses and interest in the capital invested in the Government's plant...." (104)

The various provisions of Title 33 of the U.S. Code formed the basis for dividing the available work between the Corps assets and the industry fleet. The intent of the statutes was to incorporate the industry capacity in the execution of Federal dredging work primarily to minimize the total cost to the taxpayer through competitive bidding and to obviate the need to maintain at a Federal level the only national dredge fleet. But in the view of many people, these statutes were too vague in delineating the exact method the Corps should use in proportioning work between

the Corps plant and the industry. Terms such as "reasonable" as applied to contractor prices and "what is most economical and advantageous to the United States" left the Corps with the ability to interpret these laws to a wide degree. Section 624 provided some additional guidance, but the discretionary powers of the Corps were still considered to be too great.

6.3 CHANGING CONDITIONS FORCE A REANALYSIS

The national dredging program continued on this basis up until the early 1970s. At that time, the private industry became severely threatened as a result of a nationwide decrease in dredging work. While the preceding years had a slow annual increase in cubic yards dredged, a significant reversal began in 1963 and extended into the mid 1970s. The annual dredged yardage dropped from 480 million cubic yards in 1963 to 327 million cubic yards in 1967. The total increased slightly but then dipped to a new low of 312 million cubic yards in 1973. This was a 35% decrease in total dredged yardage. (105)

During the same period, annual costs went through a different cycle. From 1963 to 1967, expenditures decreased by 34% from $166 million to $110 million; roughly paralleling the decrease in volume dredged. But from 1968 to 1973 the total expenditures increased back up to $157 million although

the annual volume dredged continued to decrease. As unit costs increased, each dredging dollar moved less and less material. (106)

The economic effects of this contracting market were not equally shared by both the Corps and the industry. This was due to a basic divergence in how the two fleets were employed. Industry dredges had historically accounted for nearly 85% of the work done in regards to improvement dredging, or New Work as it is called. The majority of the decreasing market occurred in this category. New Work annual yardage decreased from 263 million cubic yards in 1963 to 36 million cubic yards in 1973, a drop of 86%. (107) Funding levels dropped less precipitously. They decreased from $107 million in 1963 to $45 million in 1973, a 58% change. (108) Throughout these years, the only sector of Federal dredging that seemed to be increasing was in the field of maintenance dredging. The industry began to feel that the Corps was accomplishing too much of this work and offering them too little. The Corps responded that even if this was true, they had the order to defray the investment of the taxpayer in the Corps fleet.

The dredging requirements had clearly shifted in such a way that the industry was the most severely affected. The 86% decrease in New Work had the most significant impact but when coupled with the apparent growing Corps work share, the outlook for the industry became even gloomier. Thus, the dredging industry began to apply pressure to Congress and

the Corps to publicly bid all Federal dredge work. This demand was not met but the issue was finally being scrutinized by Congress. The times required a systematic and all-inclusive review of what had been happening and what the future of the Federal dredging program was going to be. Not only small dredge firms were going out of business. Some of the larger companies were also forced out of the market.

At the request of Congress, on 23 May, 1972, the General Accounting Office (GAO) published Report Number B 161330, titled "Observations on Dredging Activities and Problems." This report, reviewing the slumping dredging industry and the concurrently rising Corps activity, recommended that a comprehensive review should be undertaken to accomplish the following:

> That the Corps should undertake a comprehensive study of the national pipeline dredging requirements for the next few years and should consider various alternatives for meeting these requirements in the most economical manner.
>
> That the Corps should furnish the results of its comprehensive study to the appropriate Congressional legislative committees for their consideration in providing guidance as to the Federal role in meeting the future national dredging requirements. (109)

The GAO report recommended that the proposed study be based upon three alternatives:

> Maintaining the present level of effort with existing Corps plant
>
> Taking over a larger share of the program by expanding the Corps plant capability

Curtailing or eliminating the Corps plant capability

(110)

During the same period, Congress was reviewing the 1973 Federal Budget which included requests from the Corps for additional funding to replace the older hopper dredges in its largely obsolete fleet. Due to the controversy, the House Committee on Appropriations issued House Report Number 92-1151, "Report on the Corps of Engineers FY 1973 Budget Request." This pivotal document stated in part:

> The Committee has placed a moratorium on all proposed plans for replacement or modification of dredges which are not presently under contract, including hopper dredges, pending the comprehensive study of the national pipeline dredging requirements which the Deputy Secretary of the Army for Installations and Housing has agreed to undertake pursuant to the recommendations of the General Accounting Office on May 23, 1972.
>
> (111)

The Senate concurred in this action and expanded the limits of the proposed study to include hopper dredges within its scope. The Corps was thus under Congressional mandate to review the entire range of its activities. No fleet modernization could occur until the proposed study had been submitted to Congress. Furthermore, the possibility existed that the Corps of Engineers was about to go out of the business of owning and operating dredges.

6.4 THE NATIONAL DREDGING STUDY

6.4.1 Introduction. Pursuant to the directives embodied in House Report 92-1151 and Senate Report 92-923, an advisory committee was formed with representatives from the Corps, private dredging industry and port authorities. The advisory committee was to ensure that the required study met the Congressional guidelines and was also to provide conclusions based upon the results of the study. The prestigious management-engineering firm Arthur D. Little, Inc. was engaged to conduct the study which has become known as the National Dredging Study.

The study began in September, 1973 and was completed in August 1974. This all-inclusive and exhaustive report was divided into three major sections: (1) Past Performance, (2) Future Requirements and Procedures and (3) Government Estimating and Bidding Procedures. The major thrust of each of these sections is described below:

Part I: A detailed review and analysis of what has taken place in the Federal dredging program (and utilization of industry dredges) during the past ten years with respect to dredging operations using Corps equipment and industry equipment.

Part II: A detailed forecast of the Corps dredging program ten years ahead, considering:

a. the impact of changing requirements and the methods and equipment that might be used and related costs, and,
b. various alternatives of how the work might be shared.

Part III: A detailed review and analysis of bidding and estimating procedures, and an analysis of the effect of Corps policies and procedures on the conduct of the national dredging program. (112)

The National Dredging Study along with the recommendations of the Advisory Committee provided the most authoritative and respected analysis of the national dredging program that had ever been attempted. As reviewed in the following section, the Arthur D. Little (ADL) study provided a quantitative basis for realigning the division of work between the Corps and industry assets.

6.4.2 Past Performance (1964-1973)

6.4.2.1 Corps Fleet. This first portion of the study analyzed the status of the Corps fleet by type of dredge, regional distribution of work completed, expenditures by type of work and other similar factors. The size and make up of the Corps dredge fleet was found to be relatively static throughout the period. Thus, its condition in 1973, as shown below, was fairly typical of the entire period.

Figure 6.1: Composition of Corps Dredging Fleet, 1973

(See next page)

Dredges	Units Operating	Units Not Operating	Total	%
Hopper	16*	--	16*	32.7
Cutterhead	12	3	15	30.6
Dustpan	6	2	8	16.3
Sidecasting	3	--	3	6.1
Dipper	2	--	2	4.1
Bucket	4	1	5	10.2
	43	6	49	100.0

*Reduced to 15 in May 1974 by the sinking of the Dredge MacKenzie

(113)

It is clear that the hopper and cutter head dredges form the numerical majority of the Corps fleet. The hopper dredges were unique in that the Corps was the only owner of this type of vessel in America at that time. Therefore, all projects that were best suited to completion with hopper dredges, i.e. open water with moderate to high wave action or where dredge spoil had to be removed some distance from the site, went automatically to the Corps fleet. The utilization rate of Corps dredges by type is shown in Appendix J. This chart clearly shows that the hopper dredges were a major component of the total Corps fleet.

As previously stated, the utilization of Corps dredges was greatest in the area of maintenance dredging. The ADL study found that it accounted for 90% (200,000 dredging hours)

of the total yearly effective dredging hours. (114) The remaining 10% was devoted to new work projects. Corps involvement in new work ultimately dropped near zero in the following years.

The annual dredged yardage remained in the region of 137 million cubic yards for maintenance work. The new work yardage totals dropped, however, from 18 million cubic yards in 1964 to 8 million cubic yards in 1973; a 56% decrease. The distribution of maintenance work completed by the Corps also changed regionally during the ten years. Work of this type nearly tripled in the Gulf Coast, it remained about the same on the East Coast but dropped significantly on the West Coast and inland waterways.

The Federal tax dollars spent on Corps fleet dredging operations from 1964 to 1973 is depicted in Appendix K. From this, the predominance of the hopper dredge is reaffirmed. The clear annual rise in the cost of hopper dredge operations does not reflect a one to one relationship between costs and yards dredged. The volume moved by hopper dredges rose 13% while the associated cost increased 72%. This interesting variance is difficult to explain but certainly involves such factors as inflation, increased mobilization/demobilization costs as a result of shifting regional requirements and other elements that are less obvious.

6.4.2.2 Division of Federal Dredging Work. The ADL study also reviewed the total Federal dredging program and quan-

tified the trends that the industry had expressed concern over. The total annual dredged volumes (Corps plus industry) had indeed decreased over the ten year period. Appendix L shows the sharp drop in total yards dredged from a high of 480 million cubic yards in 1963 to a low of 327 million cubic yards in 1973. (This, and other diagrams, include data from the National Dredging Study and more recent information made available by the Office of the Chief of Engineers, U.S. Army Corps of Engineers.) Appendix M shows the increase in total cost for the entire Federal dredging program during the period when volumes were decreasing. From this, average unit dredging unit cost have been listed in Appendix N. The unit costs stayed relatively constant (decreasing volumes offset increasing costs) from 1963 until 1970, after which, unit prices began to climb upwards.

Appendixes O and P show the decrease in annual new work yardage and associated funding levels respectively. Yardage and costs appeared to have followed each other through similar trends. This similarity between yardage and costs does not appear as clearly in the area of maintenance work. Appendixes Q and R portray the increase in total annual maintenance yardage and related expenditures respectively. While costs followed a rather smooth upward curve, the yards dredged, while increasing over time, do not show a short term relationship to dredged quantities.

The proportion of Corps vs. industry expenditures for both maintenance and new work during the period 1964 to 1973 is shown in Appendix S. The division of expenditures

varied from 32% Corps/68% industry in 1964 to 39% Corps/61% industry in 1973; a shift towards the Corps of 7%. Some of the intervening years were more drastic. For example, in 1972 the proportion had nearly equalized at 46% Corps/54% industry. The ADL study had shown that the Corps role was in fact increasing during the period with a resultant decrease in industry profits resulting from decreased work levels.

Appendix T, provided by the Office of the Chief of Engineers, shows in tabular form the changes in total yardage and expenditures for the period 1963 to 1979. The details broken down into Corps and industry accounts for new work and maintenance projects. This document is included to allow a comparison between forecasts made by ADL and the actual levels.

6.4.2.3 Industry Structure During 1964-1973. The decrease in available work during the period had an irreversible impact. "While a total of almost 200 individual companies were identified as having been engaged in the dredging industry at various times during the period 1964-1972, only 87 were found to be active in 1972." (115) The study also categorized the industry based on revenues received during the year 1972; the only year when sufficient information was received. The results are listed in Figure 6.2 on the following page.

Figure 6.2: Estimated Composition of the Dredging Industry, 1972 (116)

Size	Revenue Range	No. of Firms	Estimated Dredging Revenues $ millions	% industry total
small	less than $1 million	36	12.5	5.4
medium	$1-5 million	42	89.3	38.9
large	more than $5 million	9	128.2	55.7
TOTALS		87	230.0	100.0

This data shows that only 9 companies or about 10% of the industry earned over 55% of the total industry revenues. The ADL report stated that this was not an abnormal proportion when compared to other industries. It noted, however, that the average size of the companies was rather small with only two firms earning over $20 million a year. The majority of the industry would qualify for designation as small businesses under the SBA regulations. The ADL study further states, "The structure of the industry has important implications. It indicates that the overall strength of the industry in terms of its financial resources may limit its resilience and ability to weather major long drawn out down turns in levels of dredging activity or profitability and its ability to attract the capital needed to purchase new equipment." (117)

The outlook for the industry was darkened by the fact that during the period, the industry plant was falling idle. This fact is shown in Figure 6.3 below. At best, the industry

plant was utilized less than 50% of the available time. This very low utilization rate, coupled with the small size of the firms, led inextricably to the failure of many firms. Figure 6.3 also illustrates the almost total reliance of the American dredging industry on work within the United States. The work prospects in America thus directly determine the future viability of the industry. The revenue derived from Corps and private dredging projects in 1972 are fairly representative of yearly totals. Normally, 45% of industry revenues accrue from Corps activities with the remainder coming from work done for private corporations, local and regional port authorities and similar customers. The Corps is therefore the largest single customer of the industry.

Figure 6.3: Summary of Industry National Utilization by Type of Dredge (sample survey) (118)

Year	Corps of Engineers	Ports Municipal	Private Industry	Foreign	Total Utilization
		(55 Hydraulic Dredges)			
1970	22.1%	6.4%	14.7%	1.3%	44.5%
1971	23.4%	5.7%	7.2%	.2%	36.5%
1972	19.0%	10.9%	11.4%	2.2%	43.5%
1973	21.2%	6.9%	8.7%	3.7%	40.5%
		(21 Clamshell Dredges)			
1970	11.5%	12.5%	11.5%	-	35.5%
1971	14.8%	11.3%	9.0%	-	35.1%
1972	14.9%	10.7%	10.6%	-	36.2%
1973	10.4%	5.4%	13.7%	-	29.5%

(14 Dipper/Dragline Dredges)

1970	6.6%	10.4%	9.7%	-	26/7%
1971	8.6%	14.1%	6.2%	-	28.9%
1972	25.0%	2.3%	3.6%	-	30.9%
1973	17.7%	1.1%	5.3%	-	24.1%

It is apparent that the industry had suffered some lean years and coupled with its low profitability, the outlook for plant replacement in this very capital intensive industry was described by ADL as marginal. The table that follows illustrates the poor position in which the dredging industry found itself in relation to its ability to attract new investor capital.

Figure 6.4: After Tax Return on Net Assets Comparison (119)

	1970	1971	1972	1973
Dredging Industry	5.6	6.8	7.8	4.5
Contract Construction	8.1	9.5	9.3	11.5
All manufacturing	10.0	10.9	12.2	14.9

The data for the dredging industry may be optimistic since only the larger and, hence, more profitable firms responded to the ADL study with this type of information. The ADL report concluded,

> Current practice in the dredging industry appears to be to prolong the life of capital equipment through additions, betterments, and maintenance programs. An important factor here in recent years has been the relative abundance of used equipment made available by firms that have withdrawn from the industry. As a consequence, some firms

> are operating second or third hand dredges with hulls that are twenty to thirty years old. Eventually, the industry's asset base will require replenishment with new plant and equipment. At present, on the basis of the industry's recent experience, it cannot be assumed that the necessary funds will be either available within the industry or forthcoming from other financial sources. (120)

6.4.3 Future Dredging Requirements (1974-1983)

The ADL study placed equal emphasis on attempting to determine the future levels of dredging that would be required throughout America in the ten year period following the completion date of the study. This review included both Federal and private sector dredging requirements. The need to predict the future levels of dredging activity was a crucial step in the process of determining whether the Corps role should expand, remain the same or diminish in proportion to the industry fleet.

6.4.3.1 Federal Dredging Requirements. The total annual Federally funded dredging requirements were generated based upon the input of each of the District Offices of the Corps of Engineers. Estimated annual levels of both dredged volume and associated costs (in constant 1973 dollars) were submitted by the District Offices. From this, the ADL study estimated that annual yardages would increase from 420 million cubic yards in 1974 to a peak of 670 million yards in 1979, when additional maintenance dredging would be required

for the new work projects completed up to that date. Following 1979, the annual estimated total dredged yardage was expected to level off at or near 590 million cubic yards. The regional distribution of this work is shown below and covers the entire ten year period.

Figure 6.5: Forecast of Federal Dredging Volume by Region (121)

	10 year volume (10^6 cubic yards)	% of Corps Wide Volume
Gulf Coast	3,318	60.1
Interior Waterways	856	15.5
East Coast	843	15.3
West Coast	405	7.3
Great Lakes	102	1.8
Corps Wide total	5,524	100.0

Expenditures for this level of Federal dredging effort varied from $230 million in 1974 to $420 million in 1979, followed by an annual decrease to around $315 million in 1983.

The proportion of maintenance work vs. new work on a yardage basis was estimated to be approximately 60%/40% over the ten year period. Annual Federal maintenance workloads were estimated to be between 302 and 335 million cubic yards, totalling 3.3 billion cubic yards over the entire period.

The amount of new work did not follow such smooth trends. Ten year totals were estimated at 2.2 billion cubic yards (40% of total), varying from 104 million cubic yards in 1974 to

348 million cubic yards in 1979 then dropping to 193 million cubic yards in 1983.

The total federal dredging work was estimated to follow a division of labor according to the general ratio 32% Corps (1.75 million cubic yards) vs. 68% industry contract work (3.75 million cubic yards). The associated expenditure levels for this work reflect the fact that the industry and Corps fleets would be involved in different types of dredging and thus different unit prices would pertain to each. This resulted in an estimate of $813 million (24% of total) slated to the Corps fleet while $2.6 billion (76%) would be obligated through industry contract work. The vast majority (90%) of the work scheduled for Corps completion work would be accomplished with either hopper or dustpan dredges.

6.4.3.2 Non Federal Requirements. This estimate resulted from discussions with port and harbor authorities, private industry and extrapolations of past performance. While the reliability of these estimates is not as high as ADL believed the Federal estimates to be, their use as planning figures of sufficient accuracy was defended. This data is reproduced in the table below:

(See following page.)

Figure 6.6: Non Federal Dredging Requirements by Volume (10^6 yd^3) Average Annual Forecast for Period 1974-1983. (122)

Region	Cutterhead	Clamshell
West Coast	17.4	4.7
Gulf Coast	54.1	7.0
Interior Waterways	9.9	1.3
Great Lakes	0.3	0.7
East Coast	36.0	22.2
	117.7	35.9

TOTAL = 153.6 million yd^3

The estimates for both Federal and Non Federal dredging activity on a volumetric basis are combined and depicted in Appendix U. As shown, total Federal dredging work was estimated to be 420 million cubic yards in 1974 rising to a peak of 663 million cubic yards in 1979 then declining to approximately 585 million cubic yards in 1983. Over the ten year period, the quantities dredged were expected to be increased by 39%. This favorable prediction of increased work was warmly greeted by the dredging industry once the ADL study was published.

Since then, data has been made available by the Corps for the years 1974 to 1979 listing the actual total Federal yardage dredged (Appendix T) during those years. A comparison between the estimated and actual yardage is found in

Appendix V. Similarly, the ADL study projected the total Federal annual expenditures for these same 10 years. Appendix W graphically depicts the relationship between the estimate and final figures.

As is readily apparent, the estimated totals of both yardages and expenditures were far in excess of the actual quantities moved and dollars spent. Appendix V exemplifies the fact that the farther in the future dredged yardage was estimated, the less reliable was the projection. The reason for this lack of accuracy is difficult to determine in hindsight but is a reflection of the inability to predict with any great degree of accuracy the funding levels of Congressional appropriations in the future. The entire system is affected by long and short term economic trends referred to as pork barrel legislation.

Based upon the evidence of ADL Part I, it is clear that the industry is most dependent upon the levels of new work since they garnered up to 90% of this type of work in the past. The ADL study forecasted a marked increase in new work in the years 1974-1983, a condition that would have directly benefited the industry. Appendixes X and Y show the comparison of the actual vs. estimated new work and maintenance dredging totals and their funding levels respectively. From these charts it can be seen that although maintenance dredging volume was estimated to remain constant near 315 million cubic yards annually, the actual yardage decreased over the period by approximately 10 to 15%. Associ-

ated maintenance funding levels, however, increased fairly consistently with an ending value of $265 million or a 77% increase over the estimated value for 1979.

The estimated levels of yardage for new work also departed significantly from the actual amounts. While the estimated increase of new work yardage over the five years was projected to be a rise from 115 to 345 million cubic yards, the actual new work yardage rose from 48 to 72 million cubic yards, The estimate departed from reality by almost a factor of five. The new work level was expected to increase uniformly during those years but instead the amount of work stayed fairly constant.

The funding levels shown in Appendix Y for new work show that although the actual costs consistently lagged their estimated values, the shapes of the two curves are quite similar. This situation is made less clear when it is remembered that the actual amount of new work was rather constant and, presuming similar unit costs, the actual new work costs should also have been constant during these years. The fact that they are not, reflects the annual uncertainty in unit prices for new work.

Part II of the National Dredging Study summarized the capabilities of both the Corps and the industry to meet the projected requirements. They are reviewed below. Corps requirements included:

a. 9-11 additional hopper dredges were needed

b. 5-6 additional dustpan dredges would be required

c. present fleet of 15 cutterhead dredges was judged inadequate and obsolete. No additional dredges of this type were needed due to excess industry capacity

d. existing fleet of 3 sidecaster dredges judged sufficient

e. 5 clamshell and 2 dustpan dredges judged sufficient

The ADL study conducted a separate analysis of the industry's capacity to accomplish its share of the presumed to be increasing workload. The first step was an inventory of the industry dredge fleet by type and region. The results were as follows:

Figure 6.7: Contractor Dredge Inventory (123)

Region	Hydraulic Cutterhead	Clamshell	Dipper
West Coast	38 (14%)	53 (33%)	1 (8%)
Gulf Coast	75 (28%)	23 (14%)	0 (0%)
Interior	31 (12%)	33 (21%)	5 (38%)
Great Lakes	23 (9%)	28 (17%)	4 (31%)
East Coast	97 (37%)	24 (15%)	3 (23%)
	264 100%	161 100%	13 100%

Industry total all types = 438

This inventory did not include approximately 250 small portable hydraulic dredges leased by National Car Rental, 19 plain suction dredges or the large number of dredges used to mine for construction materials or other commodities. Based upon this inventory, the industry fleet was determined to be more than capable of contending with the forecasted

total dredging workloads. The ADL study added that the industry had the capacity to expand into the foreign dredging market without reducing its ability to complete the national requirements. This conclusion is only strengthened as a result of the excessively high estimates that resulted from the ADL study.

6.4.4 Government Estimating and Bidding Procedures

The ADL study concluded with an analysis of the public bidding and government estimating process over the ten year period, 1964-1973. The data was accumulated from a review of the bids received for Federal dredging contracts throughout the United States.

During the ten year period, a total of 1,599 projects were publicly advertised. Of this total, 1,534 or 96% of the bids received ultimately resulted in contract awards. (124) Of the total, 366 (25%) of the bids were less than 80% of the government estimate, 480 (30%) were 81-100% of the government estimate, 656 (41%) were 100-125% of the government estimate and 97 or 6% were 125% of the government estimate. Since Title 33 of the U.S. code prohibits the awarding of contracts in excess of 25% of the government estimate, the 6% that fell in this category were initially unable to be awarded. Only 27 of these 97 bids were subsequently appealed by the contractors and of these 8 were finally awarded.

A similar review of past bidding records determined the number of bidders on each advertised project. Of 1493 invitations where full data was available, 435 (29%) of the projects had 5 or more bids received, 305 (20%) had 4 bidders, 369 (25%) had 3 bidders, 264 (18%) invitations resulted in 2 bidders and 120 (8%) of the total invitations resulted in only 1 bid received.

The ADL study found that 669 of the 1,599 total invitations were advertised as Small Business set aside work. It also found that over 90% of the contracts awarded were on a unit cost basis rather than lump sum.

The ADL study completed Part III by reviewing extensively the government estimating process and found that the techniques utilized throughout the various District Offices were not fully uniform. The report concluded, however, that this could be a reflection of the divergence of the industry on a regional basis and that if total uniformity was required, the results would not reflect these regional differences in the industry. The ADL study did recommend, however, that the government estimating process in such areas as definition of Small Business set aside work should be put on a more consistent basis.

6.5 ENACTMENT OF PUBLIC LAW (P.L.) 95-269

The National Dredging Study was completed and delivered

to Congress in December, 1975. This very detailed analysis of the Federal dredging program formed the basis for a potential realignment of division of work between the Corps and industry fleets. The recommendations of the study along with those of the advisory council, included a fundamental realignment of the entire program by advocating a decrease in the size of the Federal dredge plant and shift to greater utilization of the existing private fleet. This recommendation was endorsed and implemented by the Chief of the Corps of Engineers on 13 December 1976, when the Industry Capability Program (ICP) was initiated The ICP attempted to shift the burden of Federal dredge work to the industry by increasing the number of projects that were publicly advertised. This encouragement of the industry resulted in the construction of newer, more modern industry dredges.

The decision to publicly bid more dredge work was codified into law with the passage on 26 April 1978 of the Public Law 95-269 (Appendix Z). This law states in part that the Corps of Engineers shall have Federal dredging and related work completed by contract if, "private industry has the capability to do such work and it can be done at reasonable prices and in a timely manner." The disposition of the Federally owned dredge fleet was also addressed by PL 95-269. Sections 3b of the law state:

> ...the Federally owned fleet shall be reduced in an orderly manner, as determined by the Secretary (of the Army), by retirement of plant. To carry out emergency

> and national defense work the Secretary shall retain only the minimum federally owned fleet capable of performing such work...

The Corps was further directed to "undertake a study to determine the minimum federally owned fleet required to perform emergency and national defense work." This minimum federal fleet is to be "maintained to technologically modern and efficient standards...."

During this period, Congress ended the moratorium on construction of Corps dredges effective in FY 1976. Funds were then appropriated for the design and construction of three new hopper dredges that were to replace the most obsolete members of the existing fleet.

The requirement to conduct a study to determine the minimum size federal fleet was accomplished by the Engineer Studies Center of the Corps of Engineers. Two separate reports were subsequently produced. "Hopper Dredge Requirements of the U.S. Army Corps of Engineers Minimum Fleet" was completed and sent to the Office of Management and Budget (OMB) on 1 February 1979. A sister study, "Pipeline and Mechanical Dredge Requirements of the Corps of Engineers Minimum Fleet" was completed in December 1978 and is also under review by OMB. PL 95-269 requires that these studies be submitted to Congress within two years of the enactment of the law (April 1980). These two studies analyzed the capabilities of the industry to meet the challenges of PL 95-269 and recommended minimum levels of all types of

dredge plant needed to meet the guidelines of the law.

The two studies drew from the findings of the National Dredging Study and updated much of the information to reflect the changes that had occurred since its publication. The studies were based upon an analysis of potential emergency and national defense requirements which were used to define the size of the minimum federal fleet.

One of the interesting segments of this research was the depiction of the decreasing size and increasing age of the federal fleet. Figure 6.8 reflects the reduction in size of the fleet from 1938 to 1978.

Figure 6.8: Reduction of Corps Dredge Fleet, 1938-1978 (125)

Type of Dredge	1938	1940	1951	1970	1978
Sea-going hopper	28	27	20	16	14
Cutterhead pipeline	47	41	27	12	11*
Dustpan pipeline	16	15	10	8	6
Open suction pipeline	10	7	2	0	0
Dipper	14	12	5	2	1
Bucket	7	6	5	3	0
Sidecasting	0	0	0	2	3
Special Purpose	0	0	0	0	1
TOTAL	122	108	69	43	36

* Eight of these eleven cutterhead dredges have 12 inch or smaller discharges and are used in either remote or low yardage projects such as reservoir maintenance work. They are therefore not considered to be in competition with industry dredges for any significant level of contract work.

The Corps fleet is largely obsolete with an average age of 31.1 years. The mechanical and pipeline segment of the fleet is the oldest with an average age of 46.7 years. One of those dredges is 64 years old, some 40 years beyond the reasonable economic life of this type of dredge. Due to their age, frequent repairs are needed resulting in significant down-time and waits of up to 1 year for repair parts.

The minimum fleet studies must base their findings within the context of the industry's response to the ICP program since this is a measure of their ability to fill the void created by any future decrease in Corps dredge capacity. As of December 1978, 45 projects with an estimated value of $38.1 million had been advertised for public bidding. All of these contracts were of the type that the Corps would have accomplished with its own assets and would not have been open to advertisement. Of this total 23 projects were "awarded" to the Corps for completion with the remaining 22 being awarded to the industry. The result of this greater competition was an estimated savings of $9.3 million over the two year period covered by the ICP. The ICP program is scheduled to continue until 1981. At that time, the ICP results will be reviewed by Congress and will be used as a basis in determining whether or not a transition to the minimum federal fleet can begin.

Some elements of the industry have expressed doubts about the willingness of the Corps to make the ICP program

work. While the actions of the Corps to date do not indicate anything other than total commitment to the ICP, the program as a whole was further strengthened by the directives contained within Conference Report 95-1490, dated August 14, 1978. This document, a result of the FY 1979 budget review process, requires the Corps to annually make available to public bid a minimum of 30 million cubic yards of work commonly done by hopper dredge. This amount of work is now guaranteed to be bid and has allowed industry to plan for new hopper dredge acquisition.

The results and recommendations of the minimum fleet studies are currently under review by OMB and have not yet been submitted to Congress. The final recommendations have not, therefore, been made publicly available but all indications suggest that the federal fleet will continue to contract to a position smaller than the current levels. This is almost assured given the guidance of PL 95-269 which limits the future Corps fleet to a size promulgated on emergency and national defense requirements. This residual fleet will, however, continue to benefit from the guidance of PL 95-269 which permits the exclusion from public bidding of sufficient dredged volume to allow the full utilization of the minimum fleet.

The final minimum fleet studies will also define the unusual nature and capabilities which must be inherent in future Corps dredges if they are to meet the requirements of national defense oriented operations. The necessity to

dredge in very shallow water depths and during hostile-fire conditions will surely dictate a different set of design criteria than those applicable solely to peacetime projects. This will undoubtedly result in Corps dredges that will be able to operate in many diverse environments and under the most austere of conditions. These requirements will most likely result in Corps dredges that exceed the capabilities of their industry competitors. Since national defense interests extend beyond the Continental United States (CONUS), the minimum fleet must be able to operate under conditions that may be considered unusual when compared to traditional CONUS job sites. The minimum fleet will be required to meet these new guidelines. Appendix AA depicts these design guidelines. One such vessel is now under construction (Dredge Yakuina) at a cost of $18.5 million and is due for completion in mid December 1979. Designed for use primarily in shallow waters, the Yakuina will have a hopper volume of 825 cubic yards and a loaded draft of 12 feet. The shallow dredging capabilities of the Yakuina will be most useful in peacetime in such areas as the Pacific Northwest where such conditions are common.

The effects of PL 95-269 has led the major American dredging firms to enter the hopper dredge field. The North American Trailing Company, a subsidiary of Great Lakes Dock and Dredge Company, has completed two new hopper dredges while a third one is now in design. The Manhattan Island and the Sugar Island are split hull hopper dredges with a capacity

to 3,000 and 3,700 cubic yards respectively. The third such dredge is due to be completed in mid 1980 and will also be of 3,700 cubic yards capacity.

C.F. Bean, Inc. of New Orleans, has announced a $70 million investment program for construction of new dredges in response to the ICP. The first dredge of this program, the Lenel Bean, costing $35 million, was christened on 29 March, 1979. This first privately owned dustpan dredge outbid a 40 year old Corps dredge and is now working on a $1.9 million project on the lower Mississippi River. The Lenel Bean is estimated to move 22,000 cubic yards per day for 85 days with contract completion in late November 1979.

These and other new dredges mark a historic departure for the private dredging industry and indicate the viability of the ICP. Industry reaction appears cautiously optimistic with the greatest efforts coming from the industry leaders. Their ability to commit such huge sums in new dredge construction is not a simple reflection of the availability of large capital in these firms. As noted by the National Dredging Study, industry profits have been historically small. This significant commitment of funds has been permitted through the use of Title XI loan guarantees. This program permits Federal loan guarantees up to 87½% of the total construction costs of such dredges. The only proviso of Title XI is that in the event of the failure of the company or the venture, the government assumes the remainder of the loan and gains custody of the vessel. The Title XI loans are also

attractive due to the low interest rates they entail. Thus, the poor earnings history of the dredging industry should not be a total barrier to their ability to refurbish their fleet.

6.6 SUMMARY

The combined effects of the National Dredging Study, ICP program and PL 95-269 are without historical comparison in the American dredging industry. Faced with dwindling available work and a largely idle and obsolete plant, the private dredging industry contracted quantitatively throughout the 60s and the early 70s. This dismal condition is now undergoing a fundamental and positive evolutionary process.

The pivotal forces set in motion by ICP marks the beginning of a departure from the historically monopolistic basis of the federal hopper and dustpan fleet. To a large measure, this change in attitude can be attributed to Lt. Gen. Morris, Chief of the Corps of Engineers, who directed that greater public advertising of federal dredging work should be the norm. This policy guidance began in January of 1977 fully 16 months before the passage of PL 95-269. The period of transition that lies ahead will no doubt be controversial since industry capacity to fill the void created by the Corps fleet reduction must be proven in the field. The timetable will largely be a function of how rapidly the industry

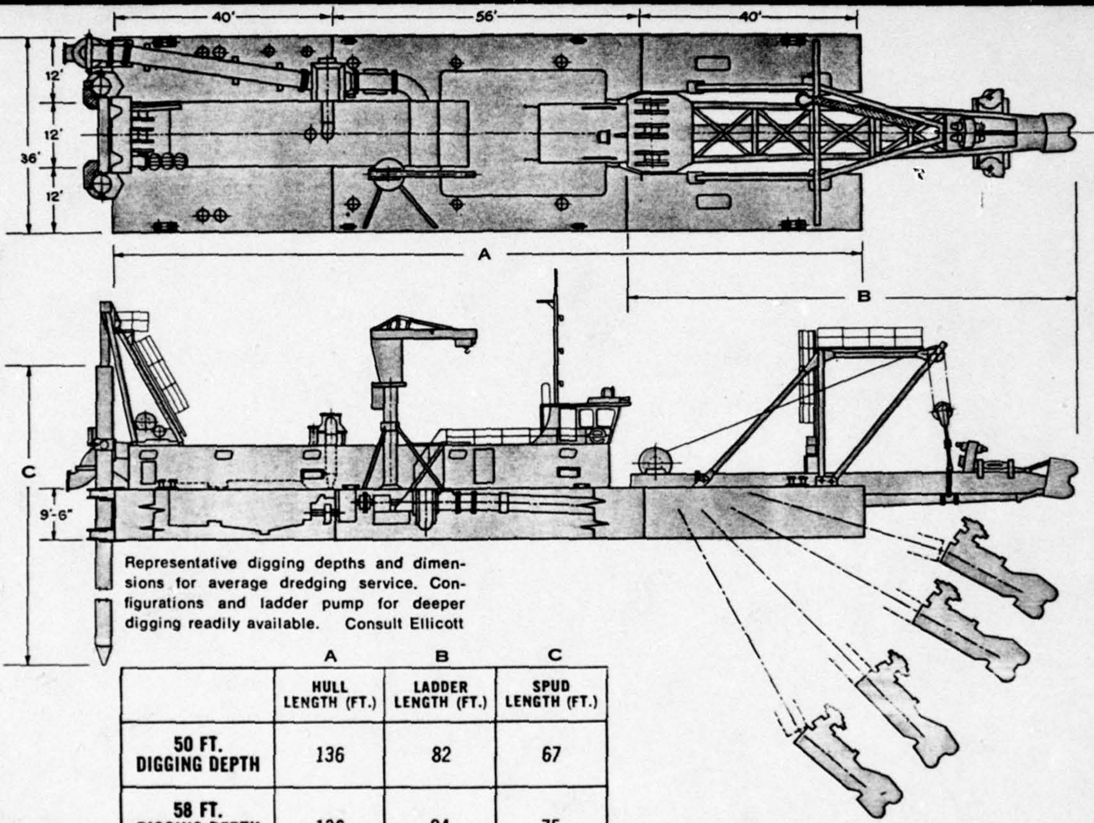
modernizes and expands its plant to meet the challenge of these two evolutionary benchmarks in American dredging.

TECHNICAL DATA AND SPECIFICATIONS

Transportable Heavy-Duty Dredge for 26" to 33" Discharge Pipeline

5000

ELLICOTT MACHINE CORPORATION DREDGE DIVISION



Representative digging depths and dimensions for average dredging service. Configurations and ladder pump for deeper digging readily available. Consult Ellicott

	A HULL LENGTH (FT.)	B LADDER LENGTH (FT.)	C SPUD LENGTH (FT.)
50 FT. DIGGING DEPTH	136	82	67
58 FT. DIGGING DEPTH (with wedge piece)	136	84	75

	MAXIMUM CHANNEL WIDTH 40° SWING EACH SIDE ℄	MINIMUM CHANNEL WIDTH
8' MINIMUM DIGGING DEPTH	230'	130' (Hull grounded)
58' MAXIMUM DIGGING DEPTH	200'	

ELLICOTT
"SUPER-DRAGON" SERIES 5000

Transportable dredges represent a revolutionary breakthrough in dredge design and construction. As equipment buyer you can now tailor the dredge you buy to suit your company's experience in the equipment you need to get the best performance and the greatest return on your investment dollar.

ELLICOTT DREDGES,
POWER-PACKED PORTABILITY

Indicate your preference for the optional equipment which you feel will satisfy your dredging requirements.

Reversible Wedge Piece for Deep or Shallow Digging □
Anchor Booms with Winches, Cable and Anchors, Hull Extended □
Stern Sheave Cable Unit (X-mas Tree) □
Clay Cutter □ Coral Cutter □ Sand-Gravel Cutter ■
Lever Room: Air Conditioned □ Heated □
DRAGOMATIC* Production-Booster □
DRAGOMETER — SOLIDS OPTIMIZER □
Basic Digging 50 ft. □ 58 ft. ■ Deeper □
Discharge I.D. 26 □ 27 □ 30 ■ 33 □
Suction I.D. 27 □ 30 ■ 33 □
Stern Discharge Swivel Elbow ■
Flap Valve in Discharge Pipe ■
Suction Vacuum Recording Gauge ■
Discharge Pressure Recording Gauge ■
Power Jib Crane over Pump ■
Interior/Exterior Lighting ■

* Trademark applied for, patent applied for
■ Standard Options
□ Special Options

5BP1273

Series 5000 "Super-Dragon" Dredge **SPECIFICATIONS . . .**

HULL AND SUPERSTRUCTURE

"SUPER-DRAGON" hull is 8-pontoon construction for stability, freeboard, and transportability. Aft center pontoon contains main pump engine unit; forward center pontoon holds auxiliary power package. Outboard pontoons for flotation, ballast, and storage of 46,000 gallons fuel. Approximate draft loaded 6 1/2 ft., 3 ft. freeboard. Wetted hull plates 3/8" thick; remainder 5/16". All bulkheads 1/4" or heavier. House: low profile, standard paneled construction for portability. Control Center: raised forward, functional design, outside access, removable for bridge clearance. Control Center designed for operator comfort and efficiency, with all control gauges and instruments located on nonglare, split bank control panel with easy-on-the-eyes night lights. Gauge grouping contains dredge pump vacuum and pressure, winch and cutter hydraulic pressure, air and service water pressure, and pump engine rpm's. Pump engine throttle control from Control Center.

DIRECT-DRIVE PUMP UNIT

Heavy-duty Ellicott dredge pump designed in accordance with our standard engineering and manufacturing practice for a pump of this size, to meet a wide range of dredging conditions.

Pump case, impeller, liners and throat piece cast of materials highly resistant to abrasion. Pump designed for fast parts replacement. Heavy-duty Kingsbury bearings on impeller shaft to improve performance.

Pump directly driven through totally enclosed oil lubricated reduction gear by 3600 HP continuous EMD 20-645E-7 engine. Engine air start complete with enclosed air clutch, oversize heavy-duty heat exchanger, oil filters. Dredge pump, diesel engine and reduction gear mounted on structural foundation which is an integral part of the hull.

EXTENDABLE LADDER

"SUPER-DRAGON" ladder of rugged flanged steel, cross-braced construction. Optional ladder inserts allow changing ladder length for different digging depths. Cutter angle can be varied by inserting new optional reversible bolt-in wedge piece, allowing good cutting and suction feed in deep or shallow digging.

EXCAVATING MODULE

"SUPER-DRAGON" 900 SHP cutter, driven by slow-speed hydraulic motors with 900 SHP rating features Caterpillar D399T-RWAC auxiliary engine, rated 1325 SHP powering "variable flow" hydraulic pumps for independent cutter circuit. Digging force at cutter blades throughout full speed range from 0 to 22 rpm, forward and reverse.

DIRECT LINE WINCHES

"SUPER-DRAGON" heavy-duty 3-drum direct line swing and ladder winch, swing rated line pull 90,800 lbs., rated line speed 0-140 feet per minute driven by heavy-duty, slow-speed hydraulic motors. Independent winch circuit powered by variable flow hydraulic pumps driven by Caterpillar D346 RWAC rated 575 SHP. Winch is built as an integral part of the aft end of the ladder. Center drum for ladder hoist and outboard drums for port and starboard swing.

"SUPER-DRAGON" 3-drum direct line spud winch, rated line pull 33,800 lbs.; rated line speed 0-73.4 ft. per minute; driven by a hydraulic motor and mounted on structural platform located under spud frame with 2 drums for spuds and 1 drum for "pull back".

HYDRAULIC POWER SYSTEM

Cutter and winch system each is of the special Ellicott "variable volume—constant torque" type, double closed loop, with independent speed reversing control. Circuits protected by pressure accumulators and quick-acting relief valves.

ELECTRICAL SYSTEM

The electrical system is powered by a 175 kw, 480 volt, 3 phase, 60 Hz continuous duty diesel generator set, equipped with 24 volt battery starting and recharging systems.

SPUDS

Two 36" O.D. heavy steel welded spuds with pointed ends, positioning holes and cross pins, lifted by heavy-duty sliding side-lift sleeves with built-in sheaves.

FRAMES

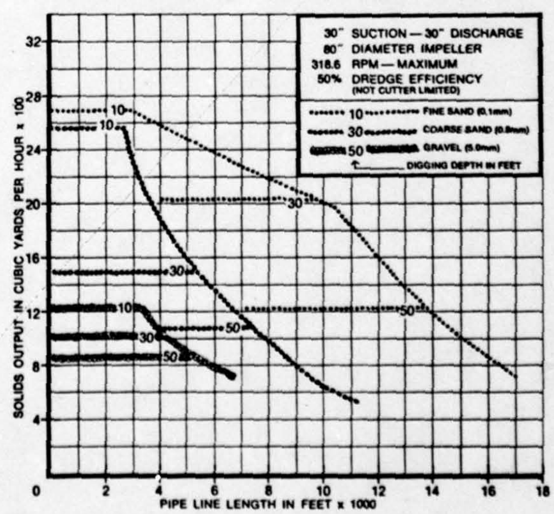
A-frame, gallows frame, and spud frame of welded box-type beam construction, pin-connected for easy mobe and demobe. Tie structure between deck and forward frames of heavy fabricated steel.

"SUPER-DRAGON" components are carefully inspected and hydraulic drive modules are shop tested. Instruction manuals, assembly drawings and parts books are furnished to assist you in field assembly, operation and maintenance. Dredging machinery designed and built by Ellicott. The right is reserved to modify our standard equipment after order to provide for engineering changes and improvements.

WARRANTY

Ellicott warrants its equipment only in accordance with the printed warranty conditions which are normally included as page 2 of our sales proposals, the latest copy of which will be forwarded to you promptly on written request. No other warranties are provided. The calculated output curves shown below represent our best engineering know-how and calculations to reflect the capability of the dredge under the conditions stated. The outputs are indicated for your reference and are not guaranteed.

SERIES 5000 CALCULATED OUTPUT CURVES



PIPELINE LENGTH IN FEET — TERMINAL ELEVATION 10 FT.

NOTE: If your capacity requirement is outside these curves, see other Ellicott models. Since actual capacities depend upon dredging depth, discharge pipe diameter, soil conditions and other project features, consult Ellicott for calculated capacities on your project.

Ellicott MACHINE CORP. (Dredge Division) ■ 1611 Bush St., Baltimore, Maryland 21230, U.S.A.

"An Equal Opportunity Employer"

Cable Address: "ELLICOTT" Telephone (301) 837-7900, TX-87621

FORM NO. 3088 - DEC. 73

TECHNICAL DATA AND SPECIFICATIONS

Density Gauge/Elbow Meter

Ellicott

PRODUCTION METER SYSTEM (EPMS)

PURPOSE

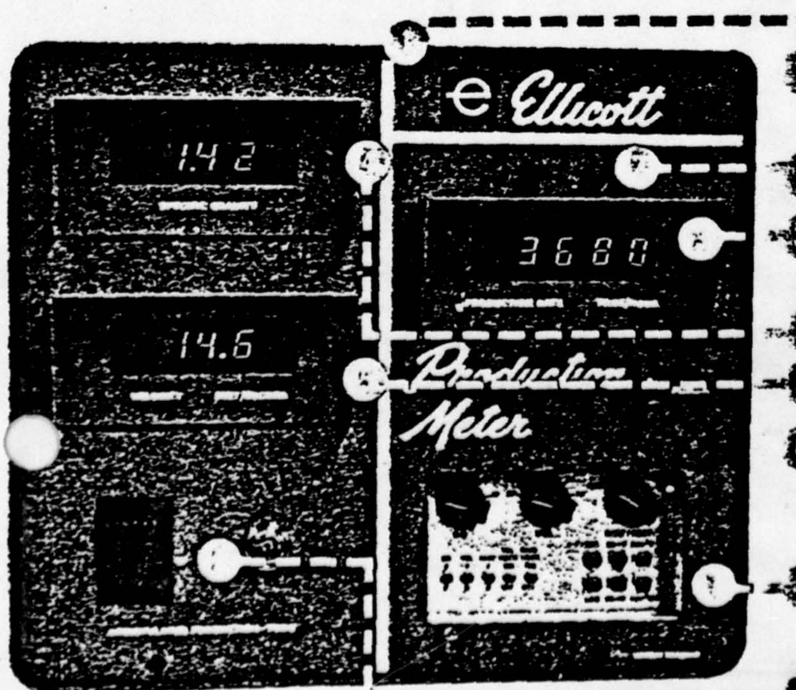
THE ELLICOTT PRODUCTION METER SYSTEM provides the Dredge Operator with information not otherwise visible from gauge reading and allows him to a. optimize the dredge operation, b. increase the solids output, and c. increase operational efficiency. The EPMS actually measures specific gravity and velocity of the water/solids mixture—displays these values on a read-out—calculates and displays production rate and accumulated production—and records this information on a special strip recorder for evaluation and permanent project record.

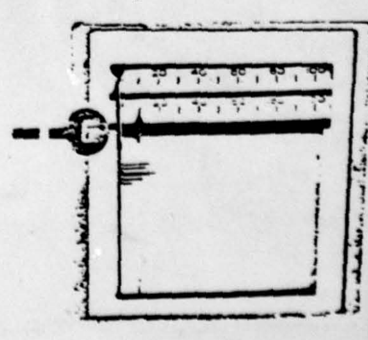
OPERATION

The EPMS measures specific gravity by means of a Nuclear Density Gauge which consists of three components—a source, a detector, and an amplifier/signal conditioner unit. The source and detector units are mounted on the section of discharge pipe which connects to the pump outlet flange. A beam of gamma radiation is transmitted from the source, through the discharge pipe, and the radiation strength is sensed by the detector located opposite the source. The strength of the radiation reaching the detector is inversely related to the specific gravity of the slurry, i.e., as the specific gravity of the slurry increases, the strength of the radiation reaching the detector decreases. The signal from the detector is transmitted to an amplifier/signal conditioner (a separate unit that can be mounted in any convenient location) which amplifies the signal from the detector, conditions it to a proper voltage, and transmits it to the read-out unit, where the value is displayed on light emitting diodes (LEDS) in a range of 1.00 S.G. (clear water) to a maximum of 1.80 S.G.

Velocity is measured by an Elbow Meter which measures the pressure differential between a pressure tap on the inside and a pressure tap on the outside of an elbow. The differential pressure from the pressure taps is converted into an electrical signal by a differential pressure transducer. The signal is not exclusively a velocity signal, since there is a variance in the pressure which is related to the specific gravity. The signal actually transmitted is the functional quantity S.G. x $(Vel)^2$. This signal is transmitted through a number of computational operational amplifiers in the read-out unit which cancel out the specific gravity and extract the square root of the velocity. The velocity signal is then displayed on LEDS in a range of 0 to 35 fps (0-10.7 mps).

Other computational modules in the read-out unit combine the specific gravity and velocity signals and solve for the instantaneous rate of production which is displayed on LEDS. This rate is integrated to obtain an accumulated production value which is displayed on an electro-mechanical counter and maintains the accumulated value even when the EPMS is turned off. The counter can be reset to 0 as desired. The instantaneous production rate and accumulated production are read in tons of solids, and the values will be correct regardless of the size or shape of the particles. Sand with a S.G. of 2.65 is used as a basis for these values and a simple correction can be made to compensate for material of different S.G.

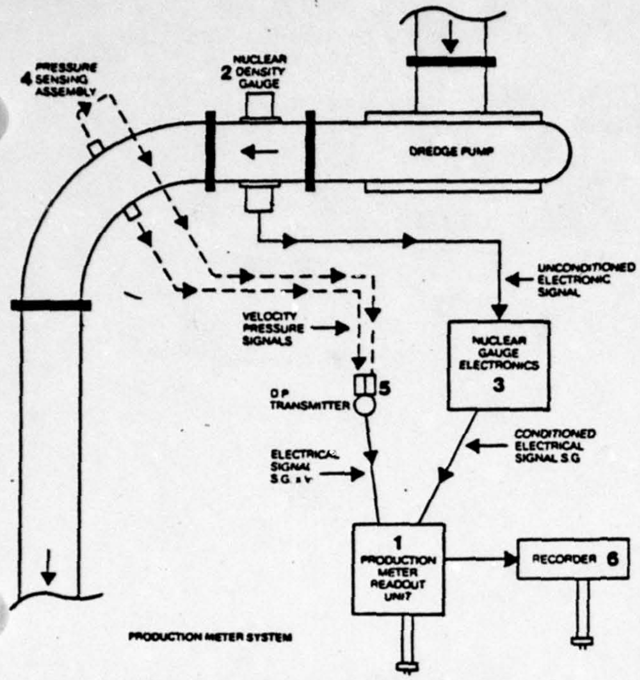




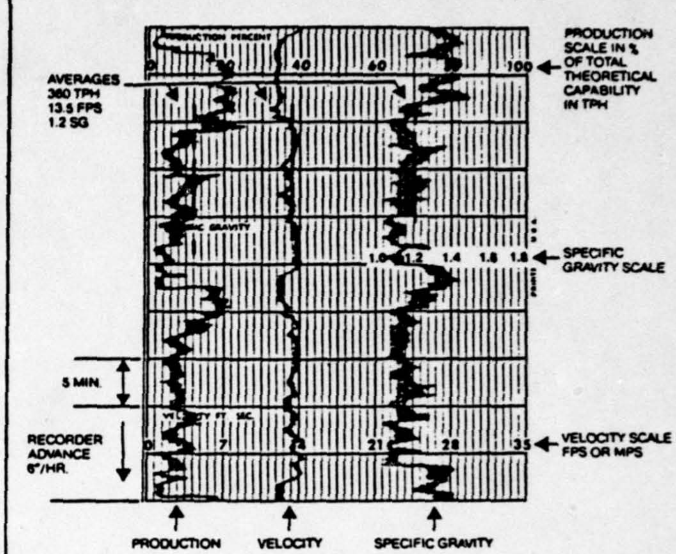
1. The production meter is entirely solid state with plug-in printed circuit boards for easy replacement.
2. Purge system warning light
3. Instantaneous production rate in tons per hour.
4. Specific gravity of the slurry.
5. Slurry velocity.
6. 3 channel strip recorder for S.G., velocity and production rate
7. Test panel for checking out all circuits.
8. Accumulated production.

PRODUCTION METER SPECIFICATIONS

ELLICOTT MACHINE CORPORATION
1611 Bush St., Baltimore, Maryland 21230, USA
Phone 301/837-7900 / TX8-7621 / Cable "ELLICOTT"



PRODUCTION METER SYSTEM



COPY OF STRIP RECORDER CHART. "DRAGON" 12"; TOTAL THEORETICAL CAPABILITY = 3000 TPH

INSTALLATION AND OPTIONS

The EPMS is adaptable to most dredges. If the system is purchased with an Ellicott dredge, all major components can be installed at the factory, with only minor field connections and calibration necessary.

The Production Meter System includes the following:

1. Electronic Read-Out Unit—computational modules and displays
2. Nuclear Gauge Source and Detector
3. Nuclear Gauge Amplifier/Signal Conditioner
4. Pressure Sensing Assemblies—Elbow Meter
5. Calibrated Differential Pressure Transducer
6. Strip Chart Recorder—3 Channel; Specific Gravity, Velocity, and Production Rate
7. A power supply of 105-125 Volt A.C. at 50-65 Hz
8. High Pressure Water for Purge/Blow Down System (minimum of 10 psi greater than discharge pressure)
9. Tubing, fittings, cables, and connections for pressure sensing assemblies and all electronics.
10. Engineering drawings and instructions
11. An engineer to calibrate, install, or supervise installation

For installation on operational dredges, necessary equipment and instruments can be shipped to the dredge. The dredge owner must supply Items 7 and 8 above.

RELIABILITY

The EPMS has been developed and tested in the Ellicott Test Facility, and many units are successfully installed on operating dredges.

All solid state components and integrated circuits (IC) of the read-out unit undergo 500 hours of high temperature and vibration testing before final assembly, and assemblies are operated and calibrated at Ellicott prior to installation.

The EPMS is entirely solid state and is composed of replaceable plug-in printed circuit (PC) boards. Displays are on light emitting diodes (LEDS), chosen for long life, reliability, and for ease of reading in all lighting conditions. The displays are mounted on printed circuit (PC) boards which are removable from the front panel individually without opening the read-out unit. Display signals are independent of each other and individually can be removed without disrupting the other display units.

The printed circuit (PC) boards of the read-out unit are keyed and cannot be incorrectly inserted and electrical connections are match-marked and keyed to prevent improper installation.

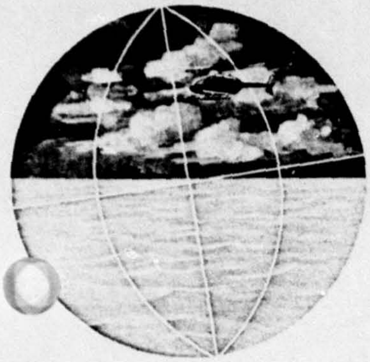
SERVICE AND MAINTENANCE

There are no wearing parts of the EPMS such as used on competitive systems. Built into the EPMS electronics are integral test circuits. A malfunction in any circuit can be isolated and the PC board malfunction can be readily indentified. Calibration pots are provided to compensate for temperature variations. Electronic technicians are normally not required, but in unusual circumstances, an Ellicott field engineer can be provided.

A set of Instruction Manuals are provided with each installation.

WARRANTY

Ellicott warrants the equipment in accordance with the printed warranty conditions which are normally included as page 2 of our sales proposals, the latest copy of which will be forwarded promptly on written request.



DEL NORTE

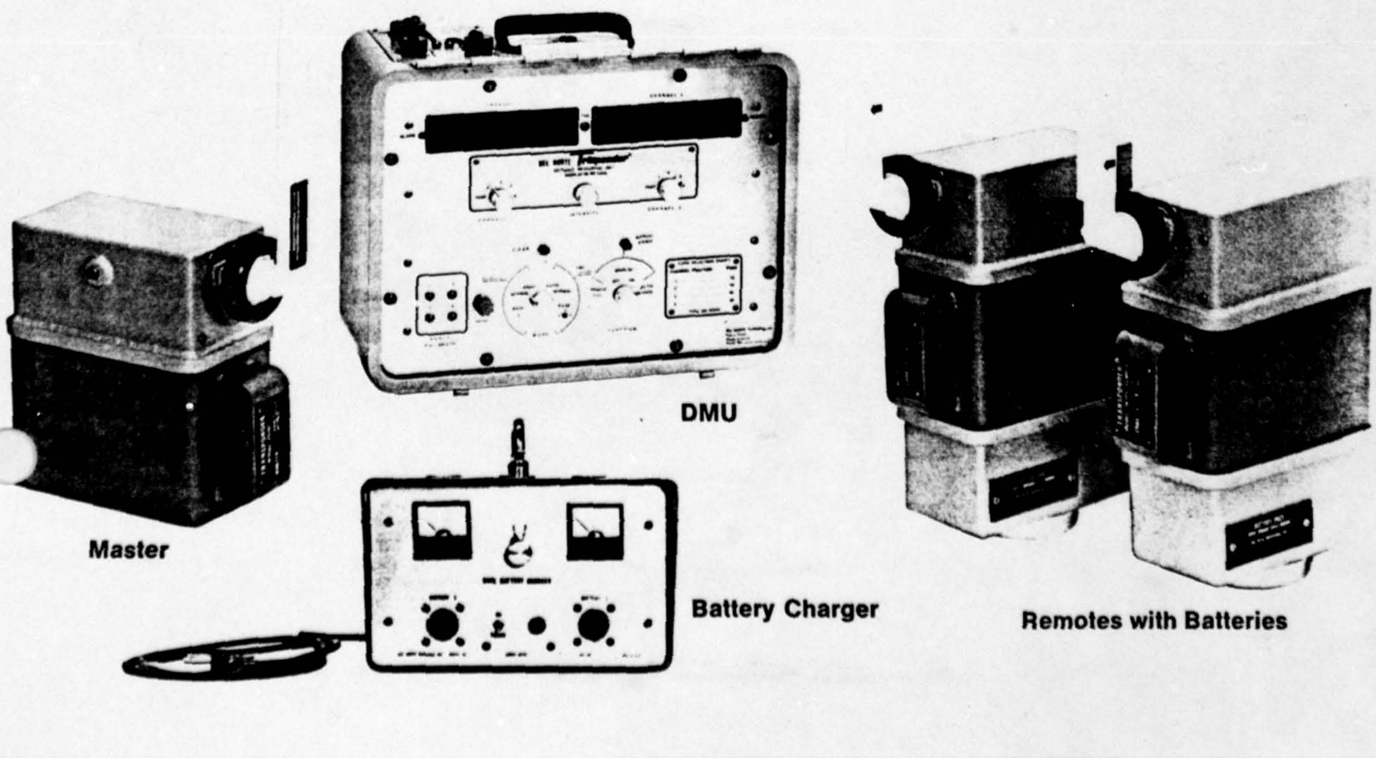
Trisponder SSX

All solid state transponders provide one-meter accuracy for improved position location

- **1 meter accuracy**
- **5 km range**
- **0.1 meter resolution**
- **self-contained rechargeable battery operation for remotes**
- **rugged waterproof construction**
- **100/1000 sum digital averaging**

With the introduction of all solid state transponders; Del Norte has once again brought the microwave positioning field another step forward. Yet this highly portable system is still easily maintained in the field. A solid state transmitter replaces the usual magnetron resulting in a much lower power drain. Self-contained batteries allow the remotes to operate some 10 hours before requiring a recharge.

Trisponder SSX also means instant on — no time delay for filament warmup. This makes the same simple automatic operation for which Trisponder is so well known, even simpler. Come to SSX for solid, dependable performance.



Master **DMU** **Battery Charger** **Remotes with Batteries**

SSX SPECIFICATIONS

Range:	5 km, line-of-sight
Accuracy:	± 1 meter
Resolution:	0.1 meter

Distance Measuring Unit

Display:	Two ranges simultaneously
Units:	Meters or Feet, 5 digits
Output:	BCD, TTL compatible
Voltage:	23 to 32 vdc
Current:	2 a
Size:	40 x 30 x 22 cm (16 x 12 x 8½ in)
Weight:	11 kg (25 pounds)
Temperature:	0 to + 67° C (+32 to 150° F)
Housing:	*Rugged waterproof case - unit floats*

260 Series Transponders

Transmitter:	Solid State, 9300-9500 MHz
Voltage:	11.5 to 30 vdc
Power:	5.5 watts @ 12 vdc
Battery Pack:	*8-hour, rechargeable*
Weight, Transponder:	3.9 kg (8½ pounds)
Weight, Battery Pack:	3.2 kg (7 pounds)
Size, less antenna, Master:	24 x 11 x 21 cm (9 x 4½ x 8½ in)
Size, Remote with Battery Pack:	35 x 11 x 21 cm (14 x 4½ x 8½ in)
Packaging:	Waterproof for marine use — unit floats
Temperature:	—30 to +70° C (—22 to +158° F)
Altitude:	760 to 1 mm Hg (approx. 30,000′)
Mounting:	1″ NPT and Tripod, 3½″-8 and ⅝ BSW
Antennas:	360° x 20° 180° x 5° 87° x 6°

SYSTEM CONFIGURATION

The standard Trisponder SSX system consists of:

- A Distance Measuring Unit
- A Master Transmitter/Receiver and Omni Antenna
- Two Remote Transmitter/Receivers, Battery Packs, and Directional Antennas
- Remote Battery Charger
- *Power and Interconnecting Cables*
- Instruction and Maintenance Manual

Additional transponder features are:

- Can be mounted on an American or European surveyor's tripod, or on a length of 1″ pipe with coupling.
- Low voltage cut-off protection
- Reverse polarity protection
- Adjacent high-power radar protection
- Plug-in, field-replaceable PC Boards
- 12′ power cord for connection to an external battery
- Interchangeability — the Master is supplied less battery pack and decoding card. With the simple addition of the decoding card and battery pack, the Master will function as a remote.

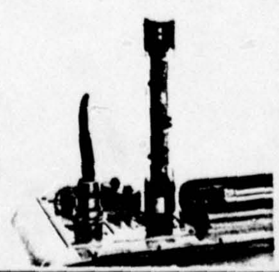
Trisponder SSX Options:

- Multi Channel DMU
  The multi channel DMU can be supplied to provide a greater flexibility in air, sea, and land positioning.
- Time Sharing Adapter
  The Time Sharing Adapter is a factory installed option to a DMU so that more than one system can operate in the same RF area.
- Serial Output
  Serial ASCII data output, RS232 compatible, can be added to the DMU. This serial output uses a separate connector and is in addition to the BCD output.

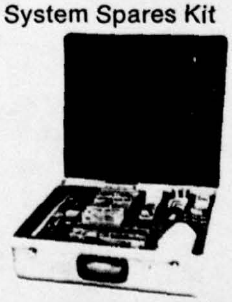
ACCESSORIES

RF Detector

Field Link Simulator



System Spares Kit



System Spares Kit Contains a set of replaceable plug-in cards for the DMU, Master and Remote Transponders. The kit also includes digital indicator, pilot lamp, fuses and assorted hardware. Shown in optional Fiberglas case.

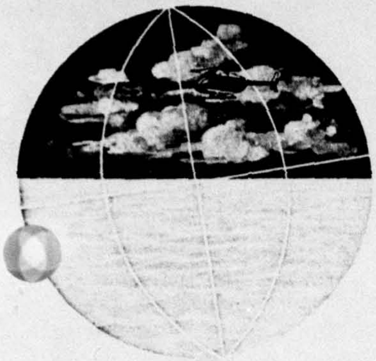
A Product of

DEL NORTE Technology, Inc.

1100 Pamela Drive, P.O. Box 696, Euless, Texas 76039
Phone AC 817 267-3541

1M6-79-OD

PRINTED IN USA



DEL NORTE

Autocarta

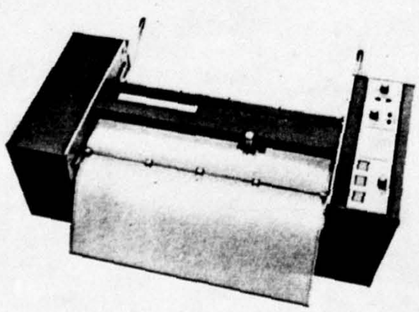
Automatic on-board recording and charting of position and depth

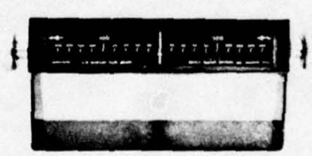
In the short time since Autocarta has been introduced, it has proven to be the most comprehensive, cost-effective aid yet placed at the disposal of the offshore surveyor.

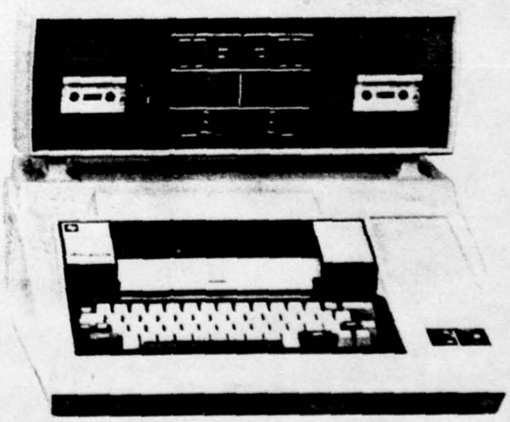
Now, one hydrographer and a helmsman employing Autocarta can replace the usual four or five typically engaged on a survey. Even the helmsman's job is simplified by means of the computer controlled left/right indicator which guides him along a preplotted course.

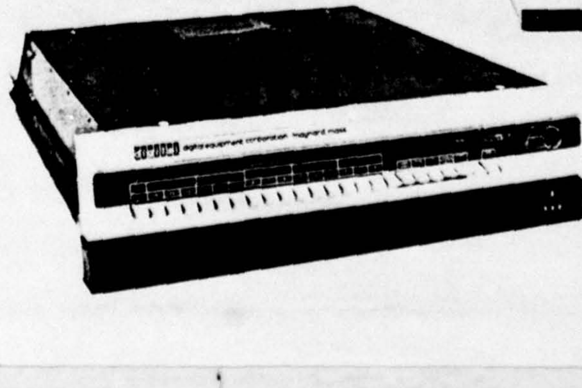
The simple to use, on-board, real-time charting capability provides versatile and sophisticated computing power previously available only through a shore based ADP "Giant". This also means, the surveyor can control and initiate any data changes he wishes, on board ship.

Autocarta, by automating many routine stages of the survey operation, relieves the surveyor/hydrographer of the tedious — and expensive — aspects of his work.



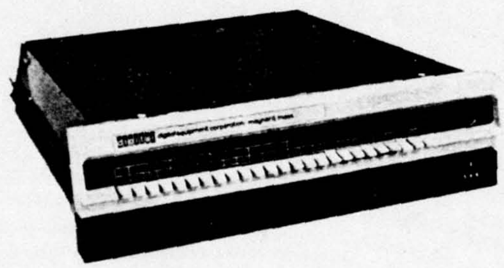




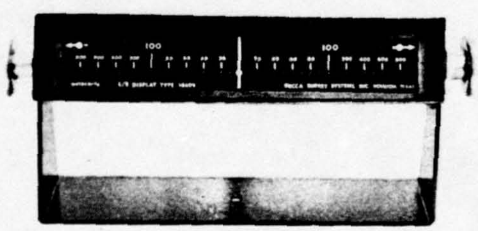


SYSTEM HARDWARE

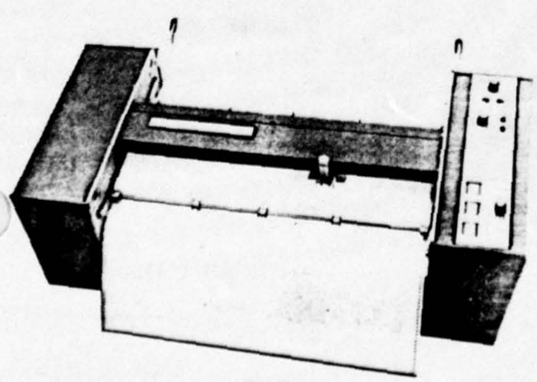
Data Terminal



Computer



Left/Right Display



Plotter

OPERATIONAL DESCRIPTION

The first things the hydrographer must establish are the parameters of a survey area and the control he intends to use. Traditionally this involves the selection of a baseline, and the preparation of charts showing the intended tracks annotated with a number of fix points. On corresponding listings, the location of each fix point would be recorded with both x-y and Range/Range values. The advent of Autocarta means that all this preparation can now take place on-board ship.

Once a baseline is selected, the limits of the survey area can be calculated to insure the greatest possible accuracy. Then Trisponder® Remotes can be set out ashore.

Autocarta Programs are of a conversational nature with input commands expressed in simple English. They are also designed to force the operator at various steps to check his input data entries before proceeding further. Thus, no programming expertise is required, and the possibility of operator error is largely eliminated.

The information entered for preparing the preplot includes the start and end co-ordinates of the line, the number of lines, and line and fix point spacing. Also, Autocarta plotter axis can be given any orientation, and a wide range of scales may be selected. Additional data relevant to the survey is similarly keyed in by the surveyor.

Having established where he wants to go, the hydrographer then proceeds to the actual survey area, using the system on-line.

The helmsman brings his vessel onto the start of the line, aided both by the track plotter, showing his actual position on the preplot chart, and also by his left/right indicator. Once the start point has been reached, the helmsman has only to watch his left/right indicator — controlled by the computer — to keep on-line.

As the vessel passes each fix point, instantaeous R/R and grid co-ordinates are recorded on the printer, together with the exact time and edited depth. Also a correlation mark is generated for other instrumentation. The x-y plotter automatically records the track made good alongside the preplot course, indicating with a cross, each recorded fix point. A pen with different colored ink will at a glance, allow the actual track to be compared with the preplot course. This, coupled with the detailed data printout, means that the system provides a real-time record of the actual survey.

Upon completion of the survey, the Autocarta data is used directly in the preparation of the final charts.

Better accuracy at lower cost perhaps best describes the many advantages of the system. Autocarta provides on-board computing power, eliminating the need for shore-based computers; better survey control leading to straighter lines; machine printout of acquired data, thereby eliminating errors likely from hand written notes; and the usefulness of an on-line x-y plot for preparing final charts.

This description of Autocarta covers its use with Trisponder for hydrographic surveys. Programs currently available also enable the system to be used for seismic work and with Hi-Fix, Pulse 8, Loran, Shoran, Raydist, and other positioning aids.

TYPICAL CHARTS

When programmed for hydrographic applications, the preplot operation is used to define a series of required survey lines. Each line is recorded on the plotter, and simultaneously grid and Range/Range values denoting its extremities are listed.

On commencement of the on-line operation, guidance information is presented to the helmsman and the actual track recorded. Shoal and mean depths each correlated with position, time, and depth count, are recorded on cassette tape. The exact position of a shoal between successive points so recorded may be subsequently established using the depth count and linear distance interpolation. At each fix point, a data printout is obtained, the track made good is annotated, and a contact closure is available for marking the depth sounder record.

```
T00 AT  0,00
•S
 CUST ID :DEL  DATE :YES
 DECCA AUTOCARTA CHART PREP PREPLOT PGM ID-911 11-30-74

 DRAW GRID? :N
 DO PREPLOTS :Y
 CHANGE BASIC CHAIN DATA? :N
 CHANGE PLOT DATA? :Y
 SCALE :5000
 PLOT ANGLE :330
   DATA OK? :Y
 SET PEN AT.REF PT
 X REF :293000
 Y REF :3311000
   DATA OK? :Y

 LINE NO :1
 START X :294141
 START Y :3312580
 END X :292013
 END Y :3315067
 LINE NO INCR. :1
 LAST LINE NO :3
 DX(LINE) :-100
 DY(LINE) :0
   DATA OK? :Y


T14 AT 17.50
•
T00 AT  0.00
•S
 CUST ID :
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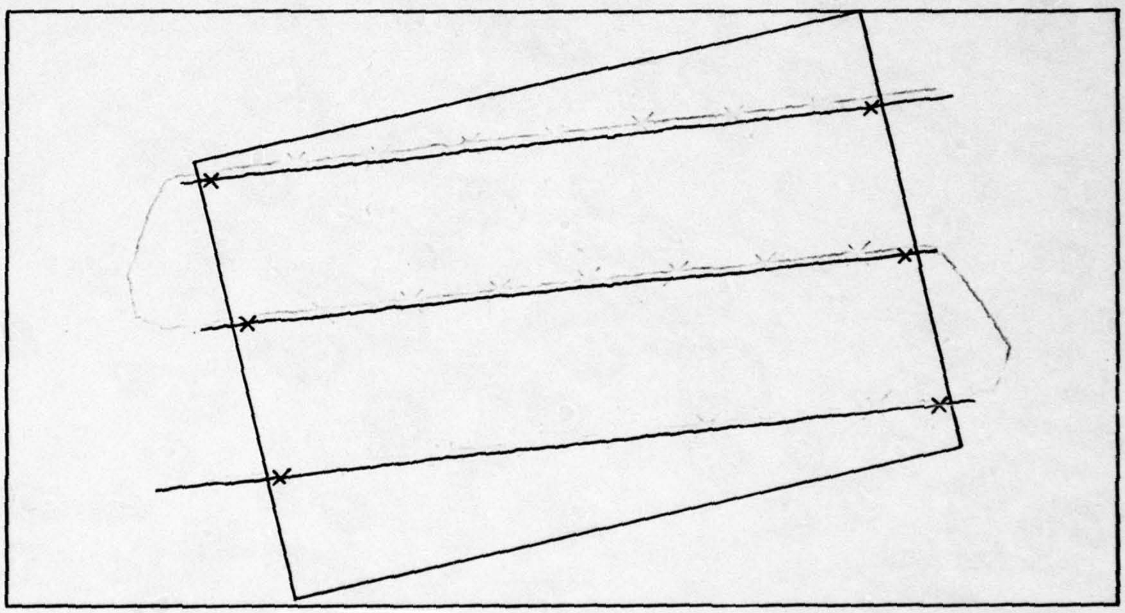
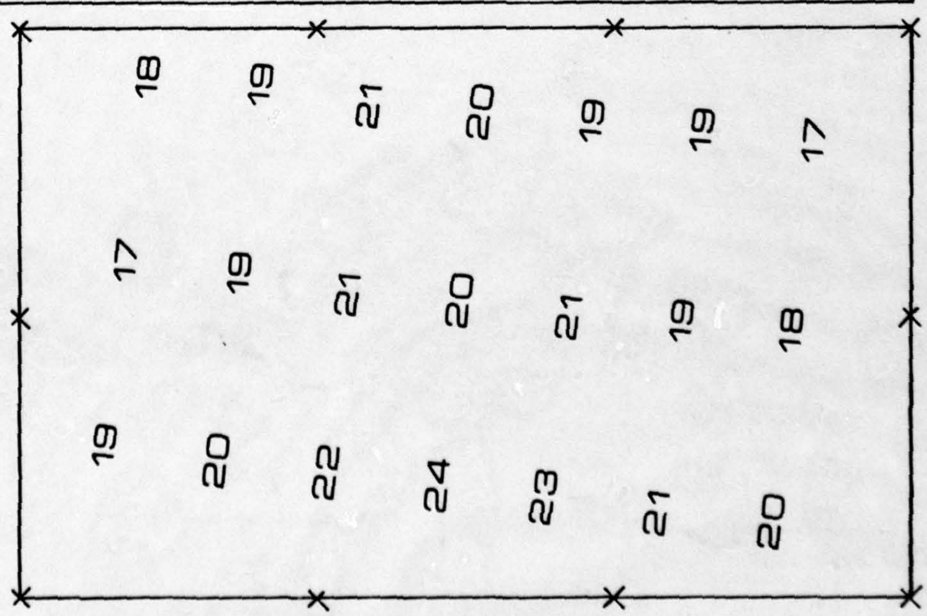
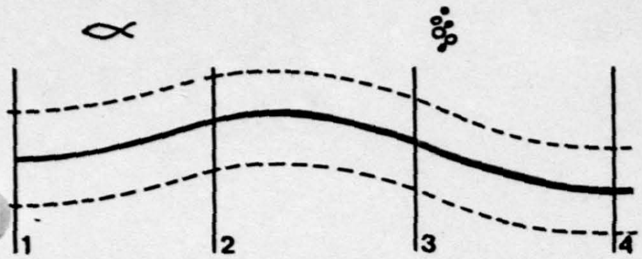




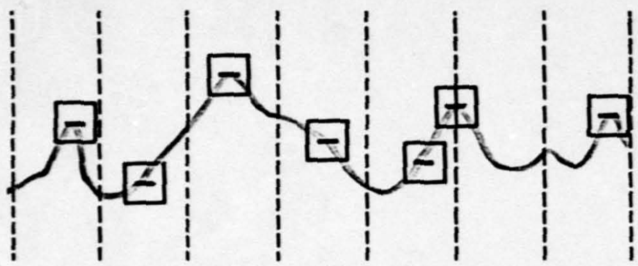
After re-programming, Autocarta is ready for an off-line charting operation where data is read from the casette tape to produce a hydrographic chart. Tide and other corrections may be applied during this phase.

Autocarta functions at any speed up to 30 knots, and at any scale within the accuracy limitations of the positioning system, provided the speed/scale factor does not exceed 1/200, e.g. 10 knots at 1/2000 or 30 knots at 1/6000.

DEPTH EDITING



Autocarta has a routine for editing depth data. A running window defines a range for the next depth based on the mean of 5 previous valid readings. This mean is up-dated whenever a new valid depth is received. The editing process starts by using a nominal depth entry as the first mean.



Over any record segment, or fix interval, usually the mean depth and position are recorded. But if a shoal is detected, then its depth and position are recorded.

Advantages

- The continually up-dated depth window assures that false echoes caused by fish, air bubbles, propeller noise, etc., will not affect the shoal or mean depth recorded.
- Mean depth computation provides a degree of swell compensation.
- Data is substantially reduced, providing an uncluttered chart, but without losing significant sea-bed features.
- Exact shoal locations are recorded.

AUTOCARTA PROGRAM CONTENT

Autocarta programs are grouped in series, each providing a number of features as shown	100 SERIES On-line Hydrographic (Preplot)	500 SERIES On-line Charting (Trackplot)	300 SERIES Off-line Charting (Postplot)
Preplot	■		
Postplot	■	■	■
Checkout	■	■	■
First Depth Edit	■	■	
Second Depth Edit			■
Tidal Reduction	■	■	■
Grid Ticks			■
Grid Annotation (with large numbers)			■
Depths Printed (on plotter while tracking)		■	
Depths Printed (on plotter off-line)			■
Selectable Plotter Scale and Orientation	■	■	■

SYSTEM SOFTWARE

In all Autocarta systems, a software package supplied on magnetic tape controls the standard hardware. A number of operational programs are available. These are packaged as necessary for each system, making it possible to largely automate the many operational requirements of different offshore survey applications. Result: Significantly reduced total project time for all systems.

Operational Program Features

Autocarta programs are all of a conversational nature, with input command requirements expressed in simple English. They are also designed to force the operator at various steps to check his input data entries before proceeding further. These features provide an ease of operation which largely eliminates the possibility of operator error.

Essentially, all Autocarta programs convert positioning system values to true survey grid co-ordinates plus depth editing. But in addition, extensive provisions are made to insure that all operations are verified. System hardware can be checked before the survey, using automated diagnostic routines. Further, a sample printout is provided to check input data validity, and to facilitate setting up the plotter. When online, data is continually verified by both depth and range gating.

HARDWARE SPECIFICATIONS

T. I. 733 ASR Data Terminal, with dual magnetic tape cassettes.
Power: 115 vac, 200 w
Weight: 22.6 kg (50 pounds)

Size:	H	W	D
	37.0 cm	53.8 cm	49.5 cm
	14.6 in	21.2 in	19.5 in

D.E.C. PDP11-05/Plessey Micro-1 Computer
Power: 115 vac, 325 w
Weight: 29.5 kg (65 pounds)

Size:	H	W	D
	16.0 cm	48.2 cm	50.8 cm
	5.25 in	19.0 in	20.0 in

Decca 10409 Left/Right Display
Power: Supplied by computer
Weight: 2.7 kg (6 pounds)

Size:	H	W	D
	16.9 cm	25.4 cm	22.9 cm
	6.6 in	10.0 in	9.0 in

Houston Instrument DP-3 20" Plotter
Power: 115 vac, 125 w
Weight: 36.2 kg (80 pounds)

Size:	H	W	D
	25.4 cm	91.4 cm	46.2 cm
	10.0 in	36.0 in	18.0 in

OPTIONAL

Houston Instrument 6655-D2 10" Plotter
Power: 115 vac, 125 w
Weight: 22.6 kg (50 pounds)

Size:	H	W	D
	24.1 cm	35.5 cm	50.2 cm
	9.5 in	14.0 in	19.75 in

DEL NORTE Technology, Inc.

1100 Pamela Drive, P.O. Box 696, Euless, Texas 76039
Phone AC 817 267-3541

Grain Size Distribution of Bottom Sediments

Per Cent Finer Than (by weight) in millimeters

District	Location	5	1	.5	.1	.05	.01	.005	.001
San Francisco	San Francisco	100	99	97	67	48	30	26	14
	Redwood City	100	99	97	96	85	55	32	12
	Oakland			100	99	97	70	55	31
	Richmond			100	92	82	51	42	25
	Pinole Shoal		100	99	60	52	39	31	20
	Mare Island			100	99	90	54	43	23
Seattle	Kingston	100	99	98	55	35	7	5	3
	Olympia	100	99	98	90	86	74	58	28
	Port Townsend	87	82	80	30	20	10	7	2
	Quillayute R.			100	50	30	8	7	5
	Willapa River		100	99	98	96	55	30	7
	Grays Harbor		100	99	86	71	36	22	10
Baltimore	Graighill					100	78	59	26
	Braverton					100	85	66	33
Norfolk	Swash Bay				100	99	65	31	10
	Sloop Channel				100	99	65	36	10
	Burtons Bay				100	99	66	38	10
Philadelphia	Edgmoor			100	90	80	59	46	27
	Darby Creek		100	99	82	70	53	43	25
New York	General	98	88	74	41	32	15	10	5
New Orleans	Calcasieu R.				100	97	73	61	34
Galveston	Galveston Hbr.		100	99	90	68	56	49	31

CRITERIA FOR DETERMINING ACCEPTABILITY OF DREDGED SPOIL DISPOSAL TO THE NATION"S WATERS

Use of Criteria

These criteria were developed as guidelines for FWQA evaluation of proposals and applications to dredge sediments from fresh and saline waters.

Criteria

The decision whether to oppose plans for disposal of dredged spoil in United States waters must be maed on a case-bycase basis after considering all approprite factors; including the following:

(a) Volume of dredged material.

(b) Existing and potential quality and use of the water in the disposal area.

(c) Other conditions at the disposal site such as depth and currents.

(d) Time of year of disposal (in relation to fish migration and spawning,etc.).

(e) Method of disposal and alternatives.

(f) Physical, chemical, and biological characteristics of the dredged material.

(g) likely recurrence and total number of disposal requests in receiving water area.

(h) Predicted long and short term effects on receiving water quality. When concentrations, in sediments, of one or more of the following pollution parameters exceed the limits expressed below, the sediment will be considered polluted in all cases and, therefor, unacceptable for open water disposal.

Sediments in Fresh and Marine Waters	Conc. % (dry wt.basis)
Volatile solids	6.0
Chemical Oxygen Demand (C.O.D.)	5.0
Total Kjeldahl Nitrogen	0.10
Oil-Grease	0.15
Mercury	0.001
Lead	0.005
Zinc	0.005

Dredged sediments having concentrations of constituents less than the limits stated above will not be automatically considered acceptable for disposal. A judgement must be made on a case-by-case basis after consid-

ering the factors in (a) through (h) above.

In addition to the analyses required to determine compliance with the stated numerical criteria, the following additional tests are recommended where appropriate and pertinent:

Total Phosphorus	Sulfides
Total Organic Carbon (TOC)	Trace Metals (iron, cadmium, copper, chromium, arsenic, and nickel)
Immediate Oxygen Demand (IOD)	Pesticides
Settleability	Bioassay

federal register

TUESDAY, JANUARY 11, 1977
PART VI

ENVIRONMENTAL PROTECTION AGENCY

OCEAN DUMPING

Final Revision of Regulations and Criteria

APPENDIX G

Title 40—Protection of Environment

(FRL 657-7)

CHAPTER I—ENVIRONMENTAL PROTECTION AGENCY

SUBCHAPTER H—OCEAN DUMPING

FINAL REVISION OF REGULATIONS AND CRITERIA

The Environmental Protection Agency today publishes final regulations and criteria with respect to the transportation of wastes for the purpose of ocean dumping. Under Title I of the Marine Protection, Research, and Sanctuaries Act of 1972, as amended, 33 U.S.C. 1401 et seq., (hereafter "the Act") the Agency on October 15, 1973, (38 FR 28610 et seq.) published regulations setting forth the procedures to be followed, and the criteria to be applied, in reviewing applications to dispose of materials in ocean waters. These rules now appear at 40 CFR Parts 220-227. In addition, the October 15 notice set forth substantive criteria to be applied in evaluating permits to discharge materials through ocean outfalls, pursuant to sections 402 and 403(c) of the Federal Water Pollution Control Act Amendments of 1972, 33 U.S.C. 1342, 1343. The regulations published today delete all reference to section 403(c) ocean outfall criteria and make Parts 220-227 (with the addition of Parts 228 and 229) solely addressed to ocean dumping and implementation of the Act. In the near future the Agency will propose significant revisions to the criteria for ocean outfalls.

The final regulations and criteria published today affect both the procedures to be followed in reviewing applications for ocean dumping and the substantive criteria to be applied in evaluating those applications.

The revisions announced today do not include changes to 40 CFR Parts 223 and 226. Significant changes will be made to those Parts in the near future. Parts 223 and 226 will be greatly expanded to present more detailed procedures for enforcement proceedings and for proceedings brought to revoke or suspend a permit pursuant to section 105(f), 33 U.S.C. 1415(f). However, these Parts as presently in force are reprinted here as they originally appeared to provide a complete set of the regulations presently in force.

The Agency believes that changes in the present regulations announced today are appropriate for several reasons:

Operating experience of EPA pointed to several ways in which the regulations required modification. There is a need to specify in more detail the considerations which go into a determination of whether a permit will be issued. The present regulations do not adequately address the regulation of ocean dumping sites. Also, some people consider the present regulations inadequate with respect to the disposal of dredged material.

A petition for additional rulemaking by the National Wildlife Federal was received in April of 1974 and pointed out several areas in which the present regulations require changes if they are to completely satisfy the Act, the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (hereafter, "Convention") open for signiature December 29, 1972, at London, and the Amendments to the Act in light of the Convention which were brought about by Pub. L. 93-254 (March 22, 1974). The Convention became effective, according to Article XIX (1), on August 30, 1975, when the fifteenth party acceded to its terms. The first Consultative Meeting of the Contracting Parties was held in London in September, 1976, and these final regulations reflect agreements on procedures reached at that meeting.

In addition to the petition from the National Wildlife Federal, an individual has requested that the emergency permit provisions contained in the regulations be modified to require more adequate public notice and opportunity for hearing prior to the issuance of those permits. EPA has thoroughly revised and expanded the ocean dumping regulations and criteria to allow for greater public participation in the program.

The Agency has held several major hearings on applications to dispose of materials; the experiences of these hearings and the Regional Administrators' experiences in reviewing applications have prompted several suggestions as to ways in which the present regulations and criteria can be improved to more adequately address the implementation of the Act and Convention, and to address the problems encountered by the Regional Administrators.

The criteria have been modified to reflect recent advances in scientific knowledge, but there is no change in EPA's intent to eliminate ocean dumping of unacceptable materials as rapidly as possible.

It is not possible to note in this preamble all the places in the regulations in which changes have been made; many modifications are minor and will not affect the day-to-day operation of the program. However, the major substantive changes have been noted below. It must be emphasized that these final regulations will replace or amend seven existing Parts of Title 40 CFR, and will add Part 228. While the regulations appear to be long and complicated, the Agency has attempted to follow a logical pattern which will make their use more convenient than one might assume at first inspection. It also must be noted that these regulations will constitute the entire set of tools one needs to implement the Act and the Convention.

These regulations and criteria were published in proposed form in the FEDERAL REGISTER on June 28, 1976, (41 FR 26644 et seq.) and a Draft Environmental Impact Statement on the criteria (Parts 227-228) was issued on July 14, 1976. The public comment period closed September 24, 1976; 75 sets of comments were received comprising some 375 pages. Some substantive technical issues were raised, and EPA held a technical workshop on October 19-20, 1976, concerning the trace contaminant and dredged material criteria. The comments received, the EPA responses to the individual comments, and the report and transcript of the technical workshop are all included in the Final Environmental Impact Statement which is available from the address given at the end of this preamble.

SUMMARY OF CHANGES MADE AS A RESULT OF COMMENTS RECEIVED

PART 220

Section 220.1—Purpose and scope. One commenter suggested that Section 220.1 (a) (3) (ii) be changed to apply these regulations to a 200-mile contiguous zone. This is not possible since the Act limits jurisdiction over foreign flag vessels to the territorial sea and the 12-mile contiguous zone of the United States. See section 2(c) of the Act, as amended by Pub. L. 93-254 (33 U.S.C. 1401).

It has been suggested that Section 220.1(c) (4) be changed to refer to "human life at sea" rather than "life at sea." The language of this section follows that of the Act. It is implicit that this section refers to human life.

Section 220.2—Definitions. The definition of sewage treatment works in paragraph (b) has been amended to make it consistent with the definition found in the FWPCA.

Section 220.3—Categories of permits.

(c)—*Emergency permits.* Consultation procedures for emergency permits have been adopted by the Contracting Parties to the International Convention. The procedures in these regulations are consistent with those adopted on an international basis.

(d)—*Interim permits.* The Agency received a substantial number of comments with respect to the interim permit provisions.

Section 220.3(d) in its revised form provides that interim permits will be issued after April 23, 1978, only to interim permit holders who have exercised best efforts to meet the requirements of a Special permit by that date and have implementation schedules adequate to allow phasing out of ocean dumping or compliance with the requirements of a special permit, by December 31, 1981.

Commenters have questioned the legality of interim permits under the Act, and have further questioned the issuance of interim permits after the 1978 deadline. Others have argued that the 1978 cutoff date is too strict. Some have suggested that this deadline be deleted altogether, with applications for interim permits to be considered on a case-by-case basis.

Interim permits are not illegal under the Act, since they do not authorize dumping which would "unreasonably" degrade or endanger the marine environment. The Act lists need for ocean dumping as one factor to be considered in issuing permits. The "need factor" has outweighed other considerations due to the lack of alternative methods of disposal and technology necessary to meet environmental criteria. The need factor

is largely a matter of time, and interim permits have been issued in order to give existing dumpers sufficient time to develop alternatives or to comply with environmental criteria. It should be noted that in no event does this section authorize dumping of materials that are absolutely barred by the Act or the Convention, or authorize dumping above trace contaminant levels of materials proscribed above trace contaminant levels.

The April 23, 1978, deadline corresponds to the fifth anniversary of the effective date of the Act. This date is significant in that Title II of the Act provides for a research program aimed at "minimizing or ending all dumping of materials within five years of the effective date of this Act." Congress has expressed impatience with the continued issuance of interim permits (see H.R. Rep. No. 94–1047, 94th Cong., 2d Sess. (1976)), and the EPA agrees that five years is sufficient time for dumpers to develop technology to end reliance on ocean dumping which violates environmental criteria.

Existing dumpers who are unable to meet the 1978 deadline may receive interim permits after that date if they have implementation schedules adequate to allow phasing out of ocean dumping or compliance with all requirements of a special permit by December 31, 1981. Experience to date has shown that, while five years is sufficient time to develop alternatives and technology, three more years are needed to implement them. The 1981 deadline is based on the implementation schedules contained in current interim permits, all of which provide for compliance or phasing out by the end of 1981. The proposed regulations required implementation schedules for industrial dumpers to provide for compliance or phasing out by April 23, 1981. Revised § 220.3(d) changes this date to December 31, 1981, since it now applies also to municipal dumpers, who are unable to meet the April 23 date.

It has been suggested that the 1981 compliance date be changed to 1979 for industrial dumpers. This change has not been made since some industrial dumpers are expected to meet the 1981 deadline but would not be able to meet a 1979 deadline. It should be stressed that § 220.3(d) requires implementation plans to provide for phasing out or compliance by December 31, 1981, at the latest. Interim permit holders who are able to meet earlier deadlines will be required to do so. Interim permits with earlier deadline dates are not to be deemed to be affected by the regulations promulgated today.

The deadlines contained in this section are based on current projections of technological feasibility, and it is reasonable to expect dumpers to meet them. The primary purpose of the Act is to protect the marine environment, and dumping in violation of environmental criteria cannot be allowed to continue indefinitely. The EPA therefore will not retain discretion to issue interim permits to applicants who do not meet the requirements of this section.

The proposed regulations authorized issuance of interim permits for sewage treatment works on a showing that the dumper had exercised best efforts to comply with the requirements of a special permit. They did not require the dumper to have an implementation schedule adequate to permit compliance or phasing out by a specific date. No deadline was imposed on municipal dumpers because of their often complicated dependence on public agency funding sources. In response to several objections, the distinction between municipal and industrial dumpers has been removed, and all holders of interim permits will now be required to meet a deadline of no later than 1981. Technology exists to permit municipalities to meet this deadline; and all interim permits currently held by municipalities provide for compliance or phasing out by the end of 1981.

Thus, the regulations promulgated today do not substantially affect the planning which must be conducted by municipalities in light of the terms of existing interim permits held by those communities. It is noted that in a letter to the Administrator dated October 26, 1976, from Congressmen Robert L. Leggett, John B. Breaux, Edwin B. Forsythe and Charles A. Mosher, all of the Subcommittee on Fisheries and Wildlife Conservation and the Environment of the Committee on Merchant Marine and Fisheries, it was strongly recommended that municipalities and industries be treated the same, with respect to interim permits. The Agency has changed the final regulations consistent with this recommendation.

New interim permits may be issued after 1978 to existing dumpers who exercise best efforts to comply with the requirements of past permits. As an example, municipal dumpers will not be denied new permits for inability, despite best efforts, to raise necessary revenues to comply with implementation schedules. While the precarious financial position of some municipalities may justify noncompliance with implementation schedules, it is expected that few, if any, exceptions will be granted by the Agency. The showing which must be made is significant, such as demonstrating that an outside construction or waste disposal firm with which the municipality has entered into contracts has become insolvent. In the past the communities employing ocean dumping as the means to dispose of sludge have on occasion submitted bare conclusions that no other alternatives are available. Not only will half-hearted attempts at compliance with the regulations and weak efforts to find alternatives not be considered to be good faith efforts under the revised criteria, but the Agency will undertake independent enforcement actions to stop such practices. It is not expected that financial reasons will be sufficient justification for noncompliance by industrial dumpers.

Section 220.3(d) authorizes issuance of interim permits after 1978 to dumpers who have implementation schedules adequate to allow phasing out of ocean dumping or compliance with the requirements of a special permit by 1981. Congressmen Leggett, Breaux, Forsythe and Mosher, in their letter of October 26, 1976, to the Administrator, have recommended that EPA make it explicit "that the choice between phasing out and complying with the criteria for a special permit is to be made by EPA—not by the applicant." Section 227.23 does make clear that this choice is up to the Regional Administrator.

Other commenters have challenged the authority of EPA to require phasing out of ocean dumping, maintaining that special permits must be issued to all applicants who meet the requirements therefor.

Subpart C of Part 227 provides that special permits may be denied to applicants who have no need to ocean dump, a factor which the Act directs the EPA to consider in issuing permits. The environmental criteria of Part 227 indicate only that the materials to be dumped by a particular dumper are not environmentally unacceptable. Since the cumulative effects of many dumpers may be environmentally unacceptable, the EPA must limit the total amount of ocean dumping and will therefore grant permits only to applicants who demonstrate lack of acceptable alternatives to ocean dumping. The purpose of implementation plans is to assure that dumping in violation of the requirements of Part 227 does not continue indefinitely. The Regional Administrators must have discretion to determine whether this purpose will be achieved by compliance with special permit requirements or by obviating the need for dumping.

Section 220.3(d) also provides that new interim permits will be issued only to applicants who demonstrate that they have exercised best efforts to comply with all requirements of previous permits.

One commenter has objected to this provision as requiring denial of permit applications for minor violations of previous permits. The same commenter has suggested that permit violations be dealt with according to the terms of the permit, rather than by denying future permits. There is no reason not to require permit holders to follow all terms of their permits in good faith, and it will be within the discretion of the Regional Administrator to determine whether best efforts have been exercised.

The primary purpose of this provision is to ensure compliance with implementation schedules. Most interim permits provide for compliance with schedules to be determined as of the expiration date of the permit. If there are no penalties for noncompliance during the term of a permit, the only way to enforce compliance is to deny subsequent permits.

There is no reason to give interim permits to dumpers who have demonstrated an unwillingness to exercise best efforts to comply with the terms of a permit.

Several minor changes have been made in § 220.3(d) in response to comments. The proposed regulations provided for the issuance of interim permits "under certain conditions in accordance with Subpart A of Part 227". One commenter requested examples of the "certain conditions" under which interim permits would issue. Since the phrase "certain conditions" referred only to the conditions specified in Subpart A and was therefore redundant, it has been deleted.

The phrase "has a treatment facility under construction" has been changed to "has an implementation schedule" since there are methods to phase out dumping or comply with environmental criteria which do not require construction of treatment facilities.

Proposed § 220.3(d) would deny interim permits to the "expansion or modification of an existing facility". Since it has been pointed out that many implementation plans require modification or expansion, this provision has been changed to deny interim permits "for the dumping of an increased amount of waste from an existing facility".

The criticism of EPA's repeated use of interim permits has come from many informed persons, and the objections have been given careful consideration. As expressed by Congressmen Leggett, Breaux, Forsythe and Mosher in the letter of October 26, 1976, to the Administrator, "EPA continues to allow a substantial volume of dangerous, toxic materials to be dumped under 'interim permit' arrangements. * * * We feel that such 'interim permits' should be summarily phased out without continued exceptions. The revised regulations * * * do not effect the intent of Congress as expressed in the Marine Protection, Research, and Sanctuaries Act of 1972."

The answer to the question of repeated use of interim permits is founded on the lack of firm scientific conclusions with respect to individual and combined dumping of wastes in the oceans. The answer to this question is inextricably linked to the issues of defining trace contaminants and to the setting of special permit conditions. If materials are in trace quantities or less, or if they comply with special permit conditions, then one need not rely on interim permits for continued dumping. Thus, by lenient definitions of trace contaminants or special permit criteria, the Agency could avoid the interim permit dilemma. Obviously, the Agency will not arbitrarily define trace contaminants or special permits to so avoid the issues.

What the Agency has attempted to do is to estimate as best it can those levels of pollutants which may be expected to cause environmental harm, to apply a safety factor, and to refuse to sanction dumping of wastes containing pollutants in these amounts unless there is no other environmentally acceptable alternative. EPA has also tried to prepare its regulations in view of criteria established under the Federal Water Pollution Control Act, State laws, and other Federal pollution control laws. Obviously it makes little sense to allow discharges of mercury through a pipe into Chesapeake Bay at levels higher than discharges from a barge into the deep ocean waters, for example. The Agency also must consider its credibility as the regulating agency. If it demands that a small community or an industry cease dumping within a period of time, it should be confident that there are feasible alternatives which may be implemented within that time period. Increasingly, this is true; and this is the reason all interim permit holders have been given firm phase-out dates. It would be improper to adopt a cessation date which has little factual foundation. Increasingly, EPA has become aware that the alternatives to ocean dumping require careful evaluation; they may not always be better.

The interim permit remains EPA's most effective tool because it requires the permittee to periodically report to EPA as to the steps being taken to cease dumping or bring the dumping within the special permit limits, allows EPA to retain conservative limits on special permits, and gives EPA the flexibility to refuse reissuance when the Agency concludes that good faith efforts to find alternatives are not being made. EPA refused to reissue an interim permit to the City of Camden.

Conceivably, EPA could abolish the category of interim permits or make interim permits of a five-year duration. This would avoid some of the stigma attached to the Agency's repeated issuance to the same applicant of interim permits. As with an artificial modification of the special permit criteria, these options are unacceptable to EPA.

It must be emphasized that the numerical limits on special permits (which define when interim permits only can be obtained) are not founded on the most precise analytical process. They may be within orders of magnitude of a "correct" limit, but there is no confident means to determine this. EPA has over the past four years conducted several open—workshops with respect to the "safe" or "unacceptable" levels of pollutants which may be dumped into the oceans. The latest was in October of this year. The only agreement reached at those sessions is that responsible scientists are not confident as to a "safe" number and that measuring environmental effects in the ocean is most difficult. With respect to any suggested alternative permit criteria, significant objections can be raised. In the discussion of § 227.6 below, more details are presented with respect to this problem.

The question, then, is not whether EPA has established environmentally unacceptable levels and continues to issue permits which violate those levels, but is whether EPA (1) has established levels which responsibly estimate concentrations of wastes not acutely toxic or otherwise clearly harmful; (2) has created a permit system which forces dumpers to find satisfactory alternatives as soon as possible; and (3) has established environmental criteria which are not inconsistent with criteria established under other laws with respect to discharges into inland waters. EPA believes it has adequately met these regulatory challenges.

(f) Permits for incineration at sea. One commenter has suggested that § 220.3(f) be revised to allow only research or interim permits to be issued for incineration at sea until criteria on this type of disposal are promulgated. This change has not been made. While there is currently insufficient information on which to base general criteria for ocean incineration, it is possible to conduct sufficient research on specific incineration projects to satisfy EPA that special permits should be issued in specific instances.

PART 221

Section 221.1—Applications for permits. This section has been revised slightly to require that applications must be in writing, but not necessarily by letter; that a full evaluation of all alternatives is not necessary; and that the environmental impact of alternatives must be considered.

Section 221.4—Adequacy of information in application. This section has been revised to allow an "adequate" description of the material to be dumped, rather than requiring a "full" description. It was pointed out that, in a practical sense, it would be impossible to ever achieve a "full" description of any material.

PART 222

In response to public comments, the Agency has made several changes in the regulations which govern procedures to be followed in reviewing applications for ocean dumping permits.

Section 222.3—Notice of applications. The Coastal Zone Management Program of the Commonwealth of Massachusetts recommended that the notice requirements of § 222.3(b) be modified to provide that the State agencies with responsibility to implement the Coastal Zone Management Act also receive notice of applications for ocean dumping permits. The requested modification has been made. Also, in paragraph (g) of that section, a sentence has been added to clarify that copies of these notices will also be sent to officials of the Departments of Commerce and Interior who are responsible for programs which may be affected by ocean dumping.

The notice provisions of § 222.3 prompted several requests for major expansion of the procedures to be followed in providing notices to the public of ocean dumping applications. Some commenters suggested that notices be placed in several newspapers in the area from which the transportation for the purpose of dumping is to commence; other commenters asked that specific provisions be included in the FEDERAL REGISTER for service of notices on particular states and private parties. Some parties stated

that the notice provision does not provide adequate time to comment on the application. Other parties are protesting that the notice provision allowed for unnecessary delay in the processing of applications.

The Agency believes that adequate notice is provided to the public by regulations promulgated today. In practice, the Regional Administrators provide substantially more notice to parties known to be interested in ocean dumping matters and to Federal and State authorities within those Regions than is provided in these regulations. The intent of the regulations promulgated today is not to dictate the procedure which may be followed in each instance but rather to state the *minimum procedures which must be* followed. Several of the commenters who wish to be provided with more elaborate notice of proposed applications may receive substantially more details on proposed dumping than is provided for in this Part by simply requesting the Regional Administrator for the Region in which they are located to so provide with respect to each ocean dumping application. Likewise, parties who believe that they will continue to have an interest in ocean dumping matters may resuest that they be sent detailed information on each application. With respect to the request that the notice provisions allow for more or less time, the Agency believes that the present regulations provide an adequate compromise between the need to allow parties to prepare adeouately for presentations at the public hearings and for the need to promptly process ocean dumping applications. The Agency is concerned that the entire permit review process may take an unreasonable period of time if lengthy periods are allowed at the various stages to provide opportunity for parties to prepare new objections or recommendations to the proposed Agency action. The present regulations attempt to allow time for responsible participation in the permit review process while at the same time expediting that process.

Section 222.4—Initiation of hearings. A change has been made to the proposed § 222.4(b). In accordance with the decision of Judge Gerhard A. Gesell in the case of "*State of Maryland et al. v. Train et al.*" (D.Md. Civil Action No. 5-1731) May 10, 1976, 8 ERC 2050, 2054, the Agency discretion with respect to the convening of the initial public hearing is narrowly circumscribed. Therefore, the final regulations state that the initial hearing may be called whenever a person properly requests such a hearing or whenever the Administrator or Regional Administrator, as the case may be, determines that such request presents genuine issues. The prior language required that the request present "substantial issues of public interest". It is intended that the Administrator or Regional Administrator deny the request for a hearing only when it is clear that the request is not in good faith or raises issues which have been clearly addressed in prior hearings when there is no new evidence. Denials of hearing requests will be rare.

Section 222.8—Recommendations of Presiding Officer. This section has been amended to provide that the recommendations of the Presiding Officer shall include a description of evidence relied upon. Most recommended decisions have already included such a description of evidence, but this amendment clarifies the requirement. It is not intended that this regulation will require that the presiding officers cite to a transcript or exhibit for every fact for which they rely upon; rather, it is merely intended to ensure that there is a clear explication of the factual bases for the recommended decision.

Section 222.9—Issuance of permits. In § 222.9(b)(1) the last phrase has been deleted because a change has been made to § 222.10(b) to the effect that the Administrator or Regional Administrator may not on their own discretion convene an adjudicatory hearing. A new paragraph (c) has been added to this section to make clear that the term of a presently valid permit may be extended pending the conclusion of the proceedings held pursuant to §§ 222.7–222.9, at the discretion of the Administrator or Regional Administrator.

Section 222.10—Appeal to adjudicatory hearing. Paragraph (a) of this section has been amended to provide that the request for an adjudicatory hearing must be sent within 10 days following the receipt of the notice of issuance or the denial of a permit. The previous language required computation of the 10 days following the dispatch of the notice. In all time requirements under the Part 222 rules, if a document is sent by the required date, it is considered timely even if it is received after the time constraint. As noted above, paragraph (b) has been changed to delete the reference to the Administrator or Regional Administrator convening a public hearing sua sponte. The original assumption was that there may be rare circumstances in which it may be *appropriate for the* Agency to convene an adjudicatory hearing to resolve difficult factual issues; it was pointed out by many commenters if there are significant factual issues involved there no doubt will be a *request for such* a hearing. Paragraph (b) has also been amended to provide that the Administrator or Regional Administrator, as the case may be, may call an adjudicatory hearing when a proper request has been made and when he determines that such a hearing is warranted. The change deletes the language requiring that such a reouest present substantial issues of public interest. This modification makes clear that discretion is allowed the Administrator or the Regional Administrator to determine the appropriateness of the convening of an adjudicatory hearing. It is anticipated that requests for adjudicatory hearings which raise genuine issues and which are brought in good faith, not in an attempt to delay, will be acted upon favorably by the Regional Administrator or Administrator. Adjudicatory hearings should be commenced as soon as possible following granting of the request. The provision in these regulations for the convening of an adjudicatory hearing is an effort by EPA to provide a forum for resolution of major factual issues which may be involved in the more significant permit proceedings.

In paragraph (c) modification has been made to allow the Administrator or Regional Administrator, prior to the conclusion of the adjudicatory hearing and appeal process, to extend the duration of the previously issued permit until a *final determination has been made*. This change follows substantially the recommendation made by the City of Philadelphia.

Section 222.11—Conduct of adjudicatory hearings. The first sentence of this section has been modified *to delete* the word "any" and insert the words "a reasonable" to modify the time in which someone must request to be admitted as a party to an adjudicatory hearing. The reason for the change is that persons should not be allowed to wait until the last minute to enter an adjudicatory hearing and thus to possibly alter the issues which have been narrowed for consideration at that hearing. The last sentence of paragraph (a) is new. It clarifies that the EPA staff will automatically be considered a party to the adjudicatory hearing.

In paragraph (d), subparagraph (6) has been deleted. This had provided that the prehearing conference could include discussion of prehearing discovery. It was concluded that prehearing discovery in most instances would be inappropriate and would lengthen the hearing to be conducted pursuant to this section beyond the time contemplated when this section was originally drafted. Of course, the Presiding Officer may request that the parties undertake informal discovery to assist in the expedition of the actual hearing, but this discovery should not be overly formal or time-consuming.

There was a great deal of comment with respect to paragraph (e), setting forth the adjudicatory hearing procedures. Much of the comment went to the statement that the burden of proof shall be on the applicant in the case of adjudicatory hearings held pursuant to § 222.10. *This subsection* has been changed. It now provides that, in the case of adjudicatory hearings held pursuant to § 222.10(b)(1), the person filing the request under § 222.10(a) has the burden of going forward as to each issue raised by that request. This suggestion substantially follows the recommendation made by the City of Philadelphia. Furthermore, references to the burden of proof have been deleted since it was deemed inappropriate to attempt to allot the burden of proof in procedural regulations. The Legislative History of the Marine Protection, Research, and Sanctuaries Act of 1972, as amended, is clear that the overall burden of persuasion rests with the applicant for permit with respect to basic issues which must be satisfied for a permit to be issued.

Paragraph (e)(5) has been changed to provide that rulings of the Presiding Officer on the admissibility of evidence,

the propriety of cross-examination, and other procedural matters merely shall appear in the record. The prior statement that these rulings shall be final has been deleted since these issues can be clearly raised on appeal. And since interlocutory appeals are disallowed, there is no necessity for such a phrase.

In paragraph (f), which addresses the procedures to be followed after the close of the adjudicatory hearing, the page limitations on briefs and other documents have been revised to allow the filing of lengthier documents.

Section 222.12—Appeal to Administrator. Consistent with changes made to other sections of Part 222, in paragraph (a) the ten-day limitation begins to run after receipt of the determination of the Regional Administrator rather than after the determination itself. Also, in later subsections of this section, the page limitations have been expanded slightly to allow more opportunity to summarize and comment on the findings and conclusions of law.

Section 222.13—Computation of time. This section is new. It has been added to clarify the means by which calculation of time should be accomplished. The section is identical to 40 CFR § 125.44, which applies to National Pollutant Discharge Elimination System Permit proceedings.

PART 223

Revisions to this Part will be promulgated in the near future.

PART 224

Section 224.2—Reports. Specific language has been added to state the type of information that must be reported when an emergency dump at sea is made.

PART 225

Section 225.2—Review of Dredge Material Permits. The requirement that EPA respond to Corps of Engineers permit actions only after a notice of intent is received has been deleted, since a permit action may be terminated prior to that point in some cases, and EPA review would normally begin prior to issuance of a notice of intent.

PART 226

Revisions to this Part will be promulgated in the near future.

PART 227

Many of the comments severely criticized the lack of a definition for "trace contaminants", the basis upon which the trace contaminant levels were set, and the differences between the dredged material criteria and the criteria for other materials. A technical workshop was convened by EPA to discuss these issues. There was general agreement among the participants that the criteria should be based, wherever possible, on impacts of dumped materials on marine ecosystems, and that these impacts could be measured best by bioassays rather than by relying on determination of total amounts of specific constituents present in a waste. The full transcript of that workshop is included in the Final EIS.

It was recognized that dredged material is merely a special case of a material containing liquid, suspended particulate, and solid phases, and that, while bioassay techniques on liquid materials have been developed to the point where they can be applied on a routine basis, bioassay techniques for the suspended particulate and solid phases of materials are still in an advanced stage of research and are not yet available for routine use. Nevertheless, the participants agreed that the criteria should be based on solid phase bioassays, recognizing that there will be an interim period during which the procedures will have to be specified on a case-by-case basis, and that such interim procedures may be less reliable and more difficult to perform than procedures which will be developed in the future.

Sections of Part 227 have been revised to reflect the recommendations of the workshop; thus, all criteria are based on ecosystem impact rather than on assumptions regarding allowable deviations from normal ambient values. These revisions are consistent with the concept of "unreasonable degradation" in these regulations and are directed toward achieving the goal of preventing significant impact on the biota. The use of bioassay results for regulatory purposes will provide EPA with direct measurements of the impact of dumping materials, so that it will no longer be necessary to infer damage indirectly through measurements related to normal ambient values.

Substantial revisions have been made in §§ 227.6, 227.13, and Subpart G. Details of the specific changes are presented below in the discussion of those sections. In general, § 227.6 has been revised to use liquid, suspended particulate, and solid phase bioassays as the basis for determining trace contaminants; § 227.13 has been changed to require bioassay results to be used in determining whether or not dredged material is environmentally acceptable for ocean dumping; and Subpart G has been revised to include definitions of liquid, suspended particulate, and solid phases, and of initial mixing allowances and limiting permissible concentrations for both liquid and solid phases.

Section 227.1—Applicability. Paragraph (b) of this section has been changed to make all of § 227.6 as well as §§ 227.9 and 227.10 applicable to dredged material, in addition to the other sections already made applicable. This is consistent with changes made in §§ 227.6, 227.13, and Subpart G.

Section 227.6—Trace contaminants. This section has been completely redrafted in response to the many comments received and to reflect the agreements reached at the technical workshop called by EPA to discuss those comments received during the public comment period. The redrafted section differs from that in the proposed regulations published on June 28, 1976:

1. The Agency is providing a broad narrative interpretation of the term "trace contaminants." The term "trace contaminants" is used in the Convention only, not in the Act. When the contracting parties to the Convention define this term, the United States will be bound by that definition. Should the Convention adopt a definition requiring more stringent operational levels than the United States is using, these levels will have to be changed accordingly. In the meantime, the Act and the Convention can be enforced effectively by stating the basis for regulation of these constituents.

Section 227.6(b) provides in general terms that these constituents will be considered as trace contaminants only when they are present in such amounts and forms that they will cause no significant undesirable effects through either toxicity or bioaccumulation.

2. Section 227.6(c) states the criteria for special permits and for wastes which otherwise can be deemed environmentally acceptable under Subpart B. Paragraph (c) of § 227.6 does not define trace contaminants; it merely states what is acceptable for ocean dumping under the environmental criteria of Subpart B. The test to be applied on all wastes is the direct determination of the impact of these constituents present in a waste on the marine ecosystem, as measured by bioassay techniques.

For liquid wastes and the liquid phases of mixed wastes, it is assumed that all of these constituents present are in forms available to the biota. Section 227.6(c) (1) provides that constituents in the liquid phase will be considered environmentally acceptable (i.e., they qualify for special permits) if they conform to the EPA marine water quality criteria. These criteria are based on the most recent and comprehensive compilation of bioassay data presently available, and recommend permissible ambient levels to avoid either chronic toxicity or potential for bioaccumulation of toxic materials, whichever factor is more restrictive. Thus, by applying the marine water quality criteria to the liquid phase, it is practical to determine environmental impact through chemical analysis.

For mercury, however, the marine water quality criteria are set near the lowest ambient levels observed in ocean waters; ambient levels in many parts of the ocean deviate from this level significantly. Therefore, an allowance for an increase in mercury of 50 percent over the local ambient level after initial mixing is allowed. This is consistent with the existing criteria for both liquid and solid phases, which are based on the range and variation of historically observed values for mercury in ocean waters and sediments. It should be noted that "normal ambient concentrations" refers to concentrations that would be present were there no dumping in the area. It should also be noted that, within areas for which a natural ambient concentration has been identified, deviations in mercury concentration up to 100 percent are not uncommon; allowing for a change of 50 percent of the average ambient levels therefore falls within the range of devi-

ation which occurs naturally in ocean waters.

There are some organohalogens for which marine water quality criteria have not been set at this time. When such compounds are present in the liquid phase of a waste, bioassay data on those specific compounds must be presented by the applicant, either through his own efforts or from a search of the scientific literature. Alternatively, a bioassy may be performed on the waste itself rather than on these specific constituents, but such bioassays must be of such a nature as to provide data on chronic toxicity and bioaccumulation potential.

For suspended particulate and solid phases, however, the state-of-the-art has not yet advanced to the point where sediment quality criteria can be set. In fact, research on benthic bioassays is only now at the stage where interim procedures can be developed and used. Nevertheless, there was general agreement among the participants at the technical workshop that even the interim procedures now available provide much better information on the impact of solid phases of waste materials on the marine ecosystem than does any form of bulk analysis. Therefore, bioassays on the solid phase are called for in the criteria, recognizing that interim procedures must be used for a period of several months until standard procedures are developed by EPA and Corps of Engineers research activities. EPA and the Corps of Engineers will publish jointly, in the very near future, standard benthic bioassay procedures. Until that time, guidance on interim procedures will be supplied by the Regional Administrator or the District Engineer. Interim and final benthic bioassay procedures acceptable for implementation of this section will deal with the chronic toxic effects or the bioaccumulation of mercury, cadmium, organohalogens, oils and greases.

The criterion for acceptability of a waste based on the solid phase bioassay is absence of significant difference between the control bioassay and the test bioassay due to the presence of any of the constituents listed in this section.

This section also recognizes that there may be carcinogens, mutagens, and teratogens, for which water quality criteria do not presently exist. In such cases, special studies may be required to establish appropriate limits. It is the intent of this section that such studies will be required, unless there is sufficient information in the scientific literature for the Regional Administrator to determine acceptable levels of these constituents for ocean dumping. If there is insufficient information in the scientific literature and the applicant is unwilling to conduct special studies, a special permit will be denied under § 227.5(c), which prohibits the dumping of materials whose properties are insufficiently described to permit application of the Criteria.

3. Provision is made for the continuing use of the existing numerical levels for solid phases as an interim measure for those cases in which satisfactory interim bioassay procedures are not available.

The present levels allow about a 50 percent deviation from normal ambient values. This is a very stringent requirement and it should be retained as a basic requirement for use when further information is not available. The language has, however, been changed to allow the application, in the case of solid materials, of a limit not more than 50 percent greater than the normal ambient value in the vicinity of the proposed dump site. This is in response to comments pointing out that the data base on which these criteria were set is quite small and may not be representative of actual oceanic sediments which may contain significantly lower concentrations of these materials than is reflected in the numerical criteria.

This section, as redrafted, applies to all materials to be dumped, including dredged materials. The terms "liquid phase", "suspended particulate", and "solid phase" are defined in § 227.32, and apply to all materials containing soluble and insoluble materials.

Section 227.7—Limits established for specific wastes or waste constituents.

Paragraph (a) has been modified to clarify its application only to liquid materials immiscible with sea-water, not those which may interact with seawater. Paragraph (c) has been changed to clarify that the intent of the paragraph is to protect human health and that of the marine ecosystem. Paragraph (d) has been changed to include a requirement for no more than 10 percent change in acidity or alkalinity for neutralization of wastes.

Section 227.10—Hazards to fishing, navigation, shorelines, and beaches. This section has been changed to include the term "unacceptable" interference or damage rather than "no" interference or damage. This change was made in response to comments which pointed out the impossibility of proving that there is no possibility of interference or damage. Applicants will be required to present reasonable evidence that interference or damage will be avoided, and the Regional Administrator will have discretion to determine what is "unacceptable".

Section 227.13—Dredged materials. This section has been completely redrafted in response to comments pointing out that the dredged material criteria were not comparable to those for other materials. As redrafted, dredged material, as well as all other wastes containing liquid, suspended particulate and solid phases, must meet the requirements of §§ 227.5, 227.6, 227.9, 227.10, 227.13, and Subpart G, in order to be environmentally acceptable for ocean disposal.

An initial screening procedure is incorporated which is similar to the requirement of § 227.12 for inert natural wastes, except that the exclusions in § 227.13 are more specific than those in § 227.12. The rationale for these exclusions is presented in the final EIS. Dredged materials which cannot meet these requirements are subject to further testing of both the liquid and solid phases. To be environmentally acceptable for ocean dumping, the liquid phase, suspended particulate phase, and solid phase must meet both the trace contaminant requirements of § 227.6 and the Limiting Permissible Concentration requirements of § 227.27.

Since the concepts of liquid phase, suspended particulate phase, and solid phase apply to all multiphase materials, the definition of the liquid phase for dredged material (i.e., the elutriate) has been removed from § 227.13 and incorporated in the definitions of Subpart G as part of § 227.32.

Section 227.15—Factors considered in determining the need for ocean dumping. Paragraph (a) has been changed to require that treatment be useful as well as feasible. Paragraph (c) has been changed to include a provision for evaluating risks to the environment for the use of alternatives. This change is also reflected in § 227.16.

Section 227.18—Factors considered. A requirement for considering impact on potential recreational and commercial use is included.

Section 227.19—Assessment of impact. A requirement for assessing the impact of alternatives is included.

Section 227.27—Limiting Permissible Concentration (LPC). This section has been redrafted to define LPC for the liquid, suspended particulate, and solid phases. The liquid phase LPC has been associated, wherever possible, with the applicable marine water quality criteria, and the suspended particulate and solid phases have been based on the avoidance of overall chronic toxicity after allowance for initial dispersion. Procedures for conducting the appropriate bioassays will be published in the near future by EPA and the Corps of Engineers. Until such procedures are published, interim guidance can be obtained from the Regional Administrator or the District Engineer.

Some commenters pointed out that the proposed regulations do not explicitly require analysis of wastes for those constituents listed in Annex II of the Convention. EPA has not specifically enumerated these constituents since it is not necessary to do so in order to determine whether or not a waste is environmentally acceptable for dumping. Section 227.27(a)(1) requires compliance with all applicable marine water quality criteria; there are criteria for all materials listed in Annex II, except fluorides. Section 227.27(a)(2) requires a bioassay to be conducted on the waste, which will reveal toxic levels of any fluorides present, as well as of other chemical constituents which, though not listed in the Convention, may be toxic. The purpose of the Act and the Convention is to prevent unacceptable or unreasonable degradation of the marine environment. The combination of bioassay procedures specified in the criteria provide information on adverse impact directly for the entire waste. Thus, the presence or absence of any specific constituent, other than those listed in Section 227.6, is not a significant factor as long as the overall impact of the waste is known.

A provision has been added in this section to allow for changes in the applica-

tion factor used to determine the LPC if there is reasonable scientific evidence on a specific waste to support such a claim. When such evidence is presented, on this or other scientific aspects of the criteria, EPA may convene an appropriate scientific review panel to examine the reasonableness of the evidence prior to taking action.

Section 227.29—Initial mixing. Initial mixing for the solid phase is included. Field data and mathematical models for predicting dispersion may be used where available; when they are not available, solid phases are assumed to be evenly distributed over the ocean bottom in an area equivalent to that of the release zone. This is an assumption, but it is a conservative one which would err on the side of environmental protection. Provision is also made in this section for using different approaches to initial mixing based on reasonable scientific evidence in specific cases.

Section 227.30—High-level radioactive wastes. It is noted that this definition, which is given in the Act, is more restrictive than that provisionally recommended by the International Atomic Energy Agency, which is the minimum standard binding on Contracting Parties to the Convention.

Section 227.31—Applicable marine water quality criteria. This is a new section added to define the applicable marine water quality criteria as being the criteria presented for marine waters in the EPA publication "Quality Criteria for Water" as amended by subsequent publications.

Section 227.32—Liquid, suspended particulate, and solid phases of materials. This is a new section added to define, for the purpose of these regulations, how liquid, suspended particulate, and solid phases are determined for different types of materials. Because some materials may interact with seawater, a general provision is included to give the Regional Administrator direction to require the use of elutriation with seawater when he has reason to believe that the elutriation procedure may reveal toxic effects which might otherwise remain hidden. These definitions apply to any multi-phase material regardless of origin; i.e., sewage sludge as well as dredged material.

The definition of the liquid phase of dredged material is the same as the definition of the elutriate in § 227.13(c) of the regulations proposed on June 28, 1976. For other materials containing both soluble and insoluble matter, the relative proportions of waste material and seawater are to be determined by EPA on a case-by-case basis. This gives EPA discretion to select the best proportions for measuring the maximum effect a material might have when dumped in seawater.

PART 228

Section 228.2—Definitions. The first sentence in this section has been changed to make that sentence consistent with other statements in Part 228. The term "disposal site" means an interim or final approved site, since the conditions of Part 228 clearly apply to those interim sites for which final Environmental Impact Statements have not yet been conducted and for which final designations, therefore, have yet to be made.

Section 228.4—Procedures for designation of sites. Paragraph (c) of this section has been revised in response to criticisms concerning the proposed procedures for designation of dredged material disposal sites. This section now explicitly states that EPA will designate dredged material disposal sites and describes the procedures that will be used.

These procedures are the same that are to be used in the designation of disposal sites for the dumping of materials under special and interim permits. The Act allows the Corps of Engineers to use other sites than those recommended by EPA when the use of EPA-designated sites is not feasible. This section requires that the same criteria be used by the Corps of Engineers in site designation as are used by EPA.

Section 228.12—Delegation of management authority for interim ocean dumping sites. The Coast Guard has withdrawn its request to have disposal sites reoriented to use LORAN-C time delay coordinates, and this section has been changed accordingly. The dredged material sites designated in § 228.4 have been added to the list of sites in the table following § 228.12.

ENVIRONMENTAL AND INFLATIONARY IMPACT STATEMENTS

Although the Agency is not required by law to prepare an Environmental Impact Statement in connection with revision of the regulations and criteria pertaining to ocean disposal, it has chosen to prepare such a statement with respect to the proposed revision to Part 227. See 39 FR 37419 (October 21, 1974). A final Environmental Impact Statement has been prepared and is available for inspection in the office noted in the last paragraph of this preamble. In addition, there are a limited number of the statements available to persons who have an interest in reviewing that document. Requests for copies should be sent to the address noted below.

Executive Order 11821 (November 27, 1974) requires that major proposals for legislation and promulgation of regulations and rules by agencies of the Executive Branch be accompanied by a statement certifying that the inflationary impact of the proposal has been evaluated; OMB Circular A-107 (January 28, 1975) prescribes guidelines for the identification and evaluation of major proposals requiring preparation of inflationary impact certifications. The Administrator has directed that EPA regulatory actions will require certification when they are likely to result in: (1) annualized costs exceeding $100,000,000; (2) total additional costs of production of any major project exceeding 5 percent of selling price; or (3) increase in net national energy consumption by the equivalent of 25,000 barrels of oil per day. None of these limiting criteria is exceeded by the proposed revisions announced today and, therefore, an inflationary impact statement has not been prepared.

These regulations and criteria will become effective February 10, 1977, and all ocean dumping permits issued after that date must be in compliance with these regulations and criteria.

The Agency will consider all written comments on these final regulations and criteria in making any future revisions. Comments should be provided in triplicate and addressed to Chief, Marine Protection Branch (WH-548), Oil and Special Materials Control Division, Environmental Protection Agency, 401 M Street SW, Washington, D.C. 20460.

(33 U.S.C. 1412 and 1418.)

Dated: December 30, 1976.

RUSSELL E. TRAIN,
Administrator.

Subchapter H of Chapter I of Title 40 is hereby amended to read as follows:

SUBCHAPTER H—OCEAN DUMPING

PART 220—GENERAL

AUTHORITY: 33 U.S.C. 1412 and 1418.

§ 220.1 Purpose and scope.

(a) *General.* This Subchapter H establishes procedures and criteria for the issuance of permits by EPA pursuant to section 102 of the Act. This Subchapter H also establishes the criteria to be applied by the Corps of Engineers in its review of activities involving the transportation of dredged material for the purpose of dumping it in ocean waters pursuant to section 103 of the Act. Except as may be authorized by a permit issued pursuant to this Subchapter H, or pursuant to section 103 of the Act, and subject to other applicable regulations promulgated pursuant to section 108 of the Act:

(1) No person shall transport from the United States any material for the purpose of dumping it into ocean waters;

(2) In the case of a vessel or aircraft registered in the United States or flying the United States flag or in the case of a United States department, agency, or in-

strumentality, no person shall transport from any location any material for the purpose of dumping it into ocean waters; and

(3) No person shall dump any material transported from a location outside the United States:

(i) Into the territorial sea of the United States; or

(ii) Into a zone contiguous to the territorial sea of the United States, extending to a line twelve nautical miles seaward from the base line from which the breadth of the territorial sea is measured, to the extent that it may affect the territorial sea or the territory of the United States.

(b) *Relationship to international agreements.* In accordance with section 102(a) of the Act, the regulations and criteria included in this Subchapter H apply the standards and criteria binding upon the United States under the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter to the extent that application of such standards and criteria do not relax the requirements of the Act.

(c) *Exclusions.* (1) *Fish wastes.* This Subchapter H does not apply to, and no permit hereunder shall be required for, the transportation for the purpose of dumping or the dumping in ocean waters of fish wastes unless such dumping occurs in:

(i) Harbors or other protected or enclosed coastal waters; or

(ii) Any other location where the Administrator finds that such dumping may reasonably be anticipated to endanger health, the environment or ecological systems.

(2) *Fisheries resources.* This Subchapter H does not apply to, and no permit hereunder shall be required for, the placement or deposit of oyster shells or other materials for the purpose of developing, maintaining or harvesting fisheries resources; provided, such placement or deposit is regulated under or is a part of an authorized State or Federal program certified to EPA by the agency authorized to enforce the regulation, or to administer the program, as the case may be; and provided further, that the National Oceanic and Atmospheric Administration, the U.S. Coast Guard, and the U.S. Army Corps of Engineers concur in such placement or deposit as it may affect their responsibilities and such concurrence is evidenced by letters of concurrence from these agencies.

(3) *Vessel propulsion and fixed structures.* This Subchapter H does not apply to, and no permit hereunder shall be required for:

(i) Routine discharges of effluent incidental to the propulsion of vessels or the operation of motor-driven equipment on vessels; or

(ii) Construction of any fixed structure or artificial island, or the intentional placement of any device in ocean waters or on or in the submerged land beneath such waters, for a purpose other than disposal when such construction or such placement is otherwise regulated by Federal or State law or made pursuant to an authorized Federal or State program certified to EPA by the agency authorized to enforce the regulations or to administer the program, as the case may be.

(4) *Emergency to safeguard life at sea.* This Subchapter H does not apply to, and no permit hereunder shall be required for, the dumping of material into ocean waters from a vessel or aircraft in an emergency to safeguard life at sea to the extent that the person owning or operating such vessel or aircraft files timely reports required by § 224.2(b).

§ 220.2 Definitions.

As used in this Subchapter H:

(a) "Act" means the Marine Protection, Research, and Sanctuaries Act of 1972, as amended (33 U.S.C. 1401);

(b) "FWPCA" means the Federal Water Pollution Control Act, as amended (33 U.S.C. 1251);

(c) "Ocean" or "ocean waters" means those waters of the open seas lying seaward of the baseline from which the territorial sea is measured, as provided for in the Convention on the Territorial Sea and the Contiguous Zone (15 UST 1606; TIAS 5639); this definition includes the waters of the territorial sea, the contiguous zone and the oceans as defined in section 502 of the FWPCA.

(d) "Material" means matter of any kind or description, including, but not limited to, dredged material, solid waste, incinerator residue, garbage, sewage, sewage sludge, munitions, radiological, chemical, and biological warfare agents, radioactive materials, chemicals, biological and laboratory waste, wreck or discarded equipment, rock, sand, excavation debris, industrial, municipal, agricultural, and other waste, but such term does not mean sewage from vessels within the meaning of section 312 of the FWPCA. Oil within the meaning of section 311 of the FWPCA shall constitute "material" for purposes of this Subchapter H only to the extent that it is taken on board a vessel or aircraft for the primary purpose of dumping.

(e) "Dumping" means a disposition of material: Provided, That it does not mean a disposition of any effluent from any outfall structure to the extent that such disposition is regulated under the provisions of the FWPCA, under the provisions of section 13 of the River and Harbor Act of 1899, as amended (33 U.S.C. 407), or under the provisions of the Atomic Energy Act of 1954, as amended (42 U.S.C. 2011), nor does it mean a routine discharge of effluent incidental to the propulsion of, or operation of motor-driven equipment on, vessels: Provided further, That it does not mean the construction of any fixed structure or artificial island nor the intentional placement of any device in ocean waters or on or in the submerged land beneath such waters, for a purpose other than disposal, when such construction or such placement is otherwise regulated by Federal or State law or occurs pursuant to an authorized Federal or State program; And provided further, That it does not include the deposit of oyster shells, or other materials when such deposit is made for the purpose of developing, maintaining, or harvesting fisheries resources and is otherwise regulated by Federal or State law or occurs pursuant to an authorized Federal or State program.

(f) "Sewage Treatment Works" means municipal or domestic waste treatment facilities of any type which are publicly owned or regulated to the extent that feasible compliance schedules are determined by the availability of funding provided by Federal, State, or local governments.

(g) "Criteria" means the criteria set forth in Part 227 of this Subchapter H.

(h) "Dredged Material Permit" means a permit issued by the Corps of Engineers under section 103 of the Act (see 33 CFR 209.120) and any Federal projects reviewed under section 103(e) of the Act (see 33 CFR 209.145).

(i) Unless the context otherwise requires, all other terms shall have the meanings assigned to them by the Act.

§ 220.3 Categories of permits.

This § 220.3 provides for the issuance of general, special, emergency, interim and research permits for ocean dumping under section 102 of the Act.

(a) *General permits.* General permits may be issued for the dumping of certain materials which will have a minimal adverse environmental impact and are generally disposed of in small quantities, or for specific classes of materials that must be disposed of in emergency situations. General permits may be issued on application of an interested person in accordance with the procedures of Part 221 or may be issued without such application whenever the Administrator determines that issuance of a general permit is necessary or appropriate.

(b) *Special permits.* Special permits may be issued for the dumping of materials which satisfy the criteria and shall specify an expiration date no later than three years from the date of issue.

(c) *Emergency permits.* For any of the materials listed in § 227.6, except as trace contaminants, after consultation with the Department of State with respect to the need to consult with parties to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter that are likely to be affected by the dumping, emergency permits may be issued to dump such materials where there is demonstrated to exist an emergency requiring the dumping of such materials, which poses an unacceptable risk relating to human health and admits of no other feasible solution. As used herein, "emergency" refers to situations requiring action with a marked degree of urgency, but is not limited in its application to circumstances requiring immediate action. Emergency permits may be issued for other materials, except those prohibited by § 227.5, without consultation with the Department of State

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when the Administrator determines that there exists an emergency requiring the dumping of such materials which poses an unacceptable risk to human health and admits of no other feasible solution.

(d) *Interim permits.* Prior to April 23, 1978, interim permits may be issued in accordance with Subpart A of Part 227 to dump materials which are not in compliance with the environmental impact criteria of Subpart B of Part 227, or which would cause substantial adverse effects as determined in accordance with the criteria of Subparts D or E of Part 227 or for which an ocean disposal site has not been designated on other than an interim basis pursuant to Part 228 of this Subchapter H; provided, however, no permit may be issued for the ocean dumping of any materials listed in § 227.5, or for any of the materials listed in § 227.6, except as trace contaminants; provided further that the compliance date of April 23, 1978, does not apply to the dumping of wastes by existing dumpers when the Regional Administrator determines that the permittee has exercised his best efforts to comply with all requirements of a special permit by April 23, 1978, and has an implementation schedule adequate to allow phasing out of ocean dumping or compliance with all requirements necessary to receive a special permit by December 31, 1981, at the latest. No interim permit will be granted for the dumping of waste from a facility which has not previously dumped wastes in the ocean (except when the facility is operated by a municipality now dumping such wastes), from a new facility, or for the dumping of an increased amount of waste from the expansion or modification of an existing facility, after the effective date of these regulations. No interim permit will be issued for the dumping of any material in the ocean for which an interim permit had previously been issued unless the applicant demonstrates that he has exercised his best efforts to comply with all provisions of the previously issued permits.

(e) *Research permits.* Research permits may be issued for the dumping of any materials, other than materials specified in § 227.5 or for any of the materials listed in § 227.6 except as trace contaminants, unless subject to the exclusion of § 227.6(g), into the ocean as part of a research project when it is determined that the scientific merit of the proposed project outweighs the potential environmental or other damage that may result from the dumping. Research permits shall specify an expiration date no later than 18 months from the date of issue.

(f) *Permits for incineration at sea.* Permits for incineration of wastes at sea will be issued only as research permits or as interim permits until specific criteria to regulate this type of disposal are promulgated, except in those cases where studies on the waste, the incineration method and vessel, and the site have been conducted and the site has been designated for incineration at sea in accordance with the procedures of § 228.4(b). In all other respects the requirements of Parts 220–228 apply.

§ 220.4 Authorities to issue permits.

(a) *Determination by Administrator.* The Administrator, or such other EPA employee as he may from time to time designate in writing, shall issue, deny, modify, revoke, suspend, impose conditions on, initiate and carry out enforcement activities and take any and all other actions necessary or proper and permitted by law with respect to general, special, emergency, interim, or research permits.

(b) *Authority delegated to Regional Administrators.* Regional Administrators, or such other EPA employees as they may from time to time designate in writing, are delegated the authority to issue, deny, modify, revoke, suspend, impose conditions on, initiate and carry out enforcement activities, and take any and all other actions necessary or proper and permitted by law with respect to special and interim permits for:

(1) The dumping of material in those portions of the territorial sea which are subject to the jurisdiction of any State within their respective Regions, and in those portions of the contiguous zone immediately adjacent to such parts of the territorial sea; and in the oceans with respect to approved waste disposal sites designated pursuant to Part 228 of this Subchapter H, and

(2) Where transportation for dumping is to originate in one Region and dumping is to occur at a location within another Region's jurisdiction conferred by order of the Administrator, the Region in which transportation is to originate shall be responsible for review of the application and shall prepare the technical evaluation of the need for dumping and alternatives to ocean dumping. The Region having jurisdiction over the proposed dump site shall take all other actions required by this Subchapter H with respect to the permit application, including without limitation, determining to issue or deny the permit, specifying the conditions to be imposed, and giving public notice. If both Regions do not concur in the disposition of the permit application, the Administrator will make the final decision on all issues with respect to the permit application, including without limitation, issuance or denial of the permit and the conditions to be imposed.

(c) *Review of Corps of Engineers Dredged Material Permits.* Regional Administrators have the authority to review, to approve or to disapprove or to propose conditions upon Dredged Material Permits for ocean dumping of dredged material at locations within the respective Regional jurisdictions. Regional jurisdiction to act under this paragraph (c) of § 220.4 is determined by the Administrator in accordance with § 228.4(e).

PART 221—APPLICATIONS FOR OCEAN DUMPING PERMITS UNDER SECTION 102 OF THE ACT

AUTHORITY: 33 U.S.C. 1412 and 1418.

§ 221.1 Applications for permits.

Applications for general, special, emergency, interim and research permits under section 102 of the Act may be filed with the Administrator or the appropriate Regional Administrator, as the case may be, authorized by Section 220.4 to act on the application. Applications shall be made in writing and shall contain, in addition to any other material which may be required, the following:

(a) Name and address of applicant;

(b) Name of the person or firm transporting the material for dumping, the name of the person(s) or firm(s) producing or processing all materials to be transported for dumping, and the name or other identification, and usual location, of the conveyance to be used in the transportation and dumping of the material to be dumped, including information on the transporting vessel's communications and navigation equipment;

(c) Adequate physical and chemical description of material to be dumped, including results of tests necessary to apply the Criteria, and the number, size, and physical configuration of any containers to be dumped;

(d) Quantity of material to be dumped;

(e) Proposed dates and times of disposal;

(f) Proposed dump site, and in the event such proposed dump site is not a dump site designated in this Subchapter H, detailed physical, chemical and biological information relating to the proposed dump site and sufficient to support its designation as a site according to the procedures of Part 228 of this Subchapter H;

(g) Proposed method of releasing the material at the dump site and means by which the disposal rate can be controlled and modified as required;

(h) Identification of the specific process or activity giving rise to the production of the material;

(i) Description of the manner in which the type of material proposed to be dumped has been previously disposed of by or on behalf of the person(s) or firm(s) producing such material;

(j) A statement of the need for the proposed dumping and an evaluation of short and long term alternative means of disposal, treatment or recycle of the material. Means of disposal shall include without limitation, landfill, well injection, incineration, spread of material over open ground; biological, chemical or physical treatment; recovery and recycle

of material within the plant or at other plants which may use the material, and storage. The statement shall also include an analysis of the availability and environmental impact of such alternatives; and

(k) An assessment of the anticipated environmental impact of the proposed dumping, including without limitation, the relative duration of the effect of the proposed dumping on the marine environment, navigation, living and non-living marine resource exploitation, scientific study, recreation and other uses of the ocean.

§ 221.2 Other information.

In the event the Administrator, Regional Administrator, or a person designated by either to review permit applications, determines that additional information is needed in order to apply the Criteria, he shall so advise the applicant in writing. All additional information requested pursuant to this § 221.2 shall be deemed part of the application and for purposes of applying the time limitation of §222.1, the application will not be considered complete until such information has been filed.

§ 221.3 Applicant.

Any person may apply for a permit under this Subchapter H even though the proposed dumping may be carried on by a permittee who is not the applicant; provided however, that the Administrator or the Regional Administrator, as the case may be, may, in his discretion, require that an application be filed by the person or firm producing or processing the material proposed to be dumped. Issuance of a permit will not excuse the permittee from any civil or criminal liability which may attach by virtue of his having transported or dumped materials in violation of the terms or conditions of a permit, notwithstanding that the permittee may not have been the applicant.

§ 221.4 Adequacy of information in application.

No permit issued under this Subchapter H will be valid for the transportation or dumping of any material which is not accurately and adequately described in the application. No permittee shall be relieved of any liability which may arise as a result of the transportation or dumping of material which does not conform to information provided in the application solely by virtue of the fact that such information was furnished by an applicant other than the permittee.

§ 221.5 Processing fees.

(a) A processing fee of $1,000 will be charged in connection with each application for a permit for dumping in an existing dump site designated in this Subchapter H.

(b) A processing fee of an additional $3,000 will be charged in connection with each application for a permit for dumping in a dump site other than a dump site designated in this Subchapter H.

(c) Notwithstanding any other provision of this § 221.5, no agency or instrumentality of the United States or of a State or local government will be required to pay the processing fees specified in paragraphs (a) and (b) of this section.

PART 222—ACTION ON OCEAN DUMPING PERMIT APPLICATIONS UNDER SECTION 102 OF THE ACT

AUTHORITY: 33 U.S.C. 1412 and 1418.

§ 222.1 General.

Decisions as to the issuance, denial, or imposition of conditions on general, special, emergency, interim and research permits under section 102 of the Act will be made by application of the criteria of Parts 227 and 228. Final action on any application for a permit will, to the extent practicable, be taken within 180 days from the date a complete application is filed.

§ 222.2 Tentative determinations.

(a) Within 30 days of the receipt of his initial application, an applicant shall be issued notification of whether his application is complete and what, if any, additional information is required. No such notification shall be deemed to foreclose the Administrator or the Regional Administrator, as the case may be, from requiring additional information at any time pursuant to § 221.2.

(b) Within 30 days after receipt of a completed permit application, the Administrator or the Regional Administrator, as the case may be, shall publish notice of such application including a tentative determination with respect to issuance or denial of the permit. If such tentative determination is to issue the permit, the following additional tentative determinations will be made:

(1) Proposed time limitations, if any;

(2) Proposed rate of discharge from the barge or vessel transporting the waste;

(3) Proposed dumping site; and

(4) A brief description of any other proposed conditions determined to be appropriate for inclusion in the permit in question.

§ 222.3 Notice of applications.

(a) *Contents.* Notice of every complete application for a general, special, interim, emergency and research permit shall, in addition to any other material, include the following:

(1) A summary of the information included in the permit application;

(2) Any tentative determinations made pursuant to paragraph (b) of § 222.2;

(3) A brief description of the procedures set forth in § 222.5 for requesting a public hearing on the application including specification of the date by which requests for a public hearing must be filed;

(4) A brief statement of the factors considered in reaching the tentative determination with respect to the permit and, in the case of a tentative determination to issue the permit, the reasons for the choice of the particular permit conditions selected; and

(5) The location at which interested persons may obtain further information on the proposed dumping, including copies of any relevant documents.

(b) *Publication.*

(1) *Special, interim and research permits.* Notice of every complete application for special, interim and research permits shall be given by:

(i) Publication in a daily newspaper of general circulation in the State in closest proximity to the proposed dump site; and

(ii) Publication in a daily newspaper of general circulation in the city in which is located the office of the Administrator or the Regional Administrator, as the case may be, giving notice of the permit application.

(2) *General permits.* Notice of every complete application for a general permit or notice of action proposed to be taken by the Administrator to issue a general permit, without an application, shall be given by publication in the FEDERAL REGISTER.

(3) *Emergency permits.* Notice of every complete application for an emergency permit shall be given by publication in accordance with paragraphs (b)(1) (i) and (ii) of this section; provided, however, that no such notice and no tentative determination in accordance with § 222.2 shall be required in any case in which the Administrator determines:

(i) That an emergency, as defined in paragraph (c) of § 220.3 exists;

(ii) That the emergency poses an unacceptable risk relating to human health;

(iii) That the emergency admits of no other feasible solution; and

(iv) That the public interest requires the issuance of an emergency permit as soon as possible.

Notice of any determination made by the Administrator pursuant to this paragraph (b)(3) shall be given as soon as practicable after the issuance of the emergency permit by publication in accordance with paragraphs (b)(1) (i) and (ii) and with paragraphs (a), (c)–(i) of this section.

(c) *Copies of notice sent to specific persons.* In addition to the publication of notice required by paragraph (b) of this section, copies of such notice will be mailed by the Administrator or the Regional Administrator, as the case may be, to any person, group or Federal, State or local agency upon request. Any such request may be a standing request for copies of such notices and shall be submitted in writing to the Administrator or to any Regional Administrator and shall relate to all or any class of permit applications which may be acted upon by the Admin-

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istrator or such Regional Administrator, as the case may be.

(d) *Copies of notice sent to States.* In addition to the publication of notice required by paragraph (b) of this section, copies of such notice will be mailed to the State water pollution control agency and to the State agency responsible for carrying out the Coastal Zone Management Act, if such agency exists, for each coastal State within 500 miles of the proposed dumping site.

(e) *Copies of notice sent to Corps of Engineers.* In addition to the publication of notice required by paragraph (b) of this section, copies of such notice will be mailed to the office of the appropriate District Engineer of the U.S. Army Corps of Engineers for purposes of section 106 (c) of the Act (pertaining to navigation, harbor approaches, and artificial islands on the outer continental shelf).

(f) *Copies of notice sent to Coast Guard.* In addition to the publication of notice required by paragraph (b) of this section, copies of such notice will be sent to the appropriate district office of the U.S. Coast Guard for review and possible suggestion of additional conditions to be included in the permit to facilitate surveillance and enforcement.

(g) *Fish and Wildlife Coordination Act.* The Fish and Wildlife Coordination Act, Reorganization Plan No. 4 of 1970, and the Act require that the Administrator or the Regional Administrator, as the case may be, consult with appropriate regional officials of the Departments of Commerce and Interior, the Regional Director of the NMFS–NOAA, and the agency exercising administrative jurisdiction over the fish and wildlife resources of the States subject to any dumping prior to the issuance of a permit under this Subchapter H. Copies of the notice shall be sent to the persons noted in paragraph (g) of this section.

(h) *Copies of notice sent to Food and Drug Administration.* In addition to the publication of notice required by paragraph (b) of this section, copies of such notice will be mailed to Food and Drug Administration, Shellfish Sanitation Branch (HF-417), 200 C Street SW., Washington, D.C. 20204.

(i) *Failure to give certain notices.* Failure to send copies of any public notice in accordance with paragraphs (c) through (h) of this section shall not invalidate any notice given pursuant to this section nor shall such failure invalidate any subsequent administrative proceeding.

(j) *Failure of consulted agency to respond.* Unless advice to the contrary is received from the appropriate Federal or State agency within 30 days of the date copies of any public notice were dispatched to such agency, such agency will be deemed to have no objection to the issuance of the permit identified in the public notice.

§ 222.4 Initiation of hearings.

(a) In the case of any permit application for which public notice in advance of permit issuance is required in accordance with paragraph (b) of § 222.3, any person may, within 30 days of the date on which all provisions of paragraph (b) of § 222.3 have been complied with, request a public hearing to consider the issuance or denial of, or the conditions to be imposed upon, such permit. Any such request for a public hearing shall be in writing, shall identify the person requesting the hearing, shall state with particularity any objections to the issuance or denial of, or to the conditions to be imposed upon, the proposed permit, and shall state the issues which are proposed to be raised by such person for consideration at a hearing.

(b) Whenever (1) a written request satisfying the requirements of paragraph (a) of this section has been received and the Administrator or Regional Administrator, as the case may be, determines that such request presents genuine issues, or (2) the Administrator or Regional Administrator, as the case may be, determines in his discretion that a public hearing is necessary or appropriate, the Administrator or the Regional Administrator, as the case may be, will set a time and place for a public hearing in accordance with § 222.5, and will give notice of such hearing by publication in accordance with § 222.3.

(c) In the event the Administrator or the Regional Administrator, as the case may be, determines that a request filed pursuant to paragraph (a) of this section does not comply with the requirements of such paragraph (a) or that such request does not present substantial issues of public interest, he shall advise, in writing, the person requesting the hearing of his determination.

§ 222.5 Time and place of hearings.

Hearings shall be held in the State in closest proximity to the proposed dump site, whenever practicable, and shall be set for the earliest practicable date no less than 30 days after the receipt of an appropriate request for a hearing or a determination by the Administrator or the Regional Administrator, as the case may be, to hold such a hearing without such a request.

§ 222.6 Presiding Officer.

A hearing convened pursuant to this Subchapter H shall be conducted by a Presiding Officer. The Administrator or Regional Administrator, as the case may be, may designate a Presiding Officer. For adjudicatory hearings held pursuant to § 222.11, the Presiding Officer shall be an Administrative Law Judge.

§ 222.7 Conduct of public hearing.

The Presiding Officer shall be responsible for the expeditious conduct of the hearing. The hearing shall be an informal public hearing, not an adversary proceeding, and shall be conducted so as to allow the presentation of public comments. When the Presiding Officer determines that it is necessary or appropriate, he shall cause a suitable record, which may include a verbatim transcript, of the proceedings to be made. Any person may appear at a public hearing convened pursuant to § 222.5 whether or not he requested the hearing, and may be represented by counsel or any other authorized representative. The Presiding Officer is authorized to set forth reasonable restrictions on the nature or amount of documentary material or testimony presented at a public hearing, giving due regard to the relevancy of any such information, and to the avoidance of undue repetitiveness of information presented.

§ 222.8 Recommendations of Presiding Officer.

Within 30 days following the adjournment of a public hearing convened pursuant to § 222.5, or within such additional period as the Administrator or the Regional Administrator, as the case may be, may grant to the Presiding Officer for good cause shown, and after full consideration of the comments received at the hearing, the Presiding Officer will prepare and forward to the Administrator or to the Regional Administrator, as the case may be, written recommendations relating to the issuance or denial of, or conditions to be imposed upon, the proposed permit and the record of the hearing, if any. Such recommendations shall contain a brief statement of the basis for the recommendations including a description of evidence relied upon in justification either (1) for permit provisions which differ from any tentative determinations issued prior to the hearing or (2) for any permit denial. Copies of the Presiding Officer's recommendations shall be provided to any interested person on request, without charge. Copies of the record will be provided in accordance with 40 CFR 2.

§ 222.9 Issuance of permits.

(a) Within 30 days following receipt of the Presiding Officer's recommendations or, where no hearing has been held, following the close of the 30-day period for requesting a hearing as provided in § 222.4, the Administrator or the Regional Administrator, as the case may be, shall make a determination with respect to the issuance, denial, or imposition of conditions on, any permit applied for under this Subchapter H and shall give notice to the applicant and to all persons who registered their attendance at the hearing by providing their name and mailing address, if any, by mailing a letter stating the determination and stating the basis therefor in terms of the Criteria.

(b) Any determination to issue or deny any permit after a hearing held pursuant to § 222.7 shall take effect no sooner than:

(1) 10 days after notice of such determination is given if no request for an adjudicatory hearing is filed in accordance with § 222.10(a); or

(2) 20 days after notice of such determination is given if a request for an adjudicatory hearing is filed in accordance with paragraph (a) of § 222.10 and the Administrator or the Regional Administrator, as the case may be, denies such request in accordance with paragraph (c) of § 222.10; or

(3) The date on which a final determination has been made following an

adjudicatory hearing held pursuant to § 222.11.

(c) The Administrator or Regional Administrator, as the case may be, may extend the term of a previously issued permit pending the conclusion of the proceedings held pursuant to §§ 222.7–222.9.

(d) A copy of each permit issued shall be sent to the appropriate District Office of the U.S. Coast Guard.

§ 222.10 Appeal to adjudicatory hearing.

(a) Within 10 days following the receipt of notice of the issuance or denial of any permit pursuant to § 222.9 after a hearing held pursuant to § 222.7, any interested person who participated in such hearing may request that an adjudicatory hearing be held pursuant to § 222.11 for the purpose of reviewing such determination, or any part thereof. Any such request for an adjudicatory hearing shall be filed with the Administrator or the Regional Administrator, as the case may be, and shall be in writing, shall identify the person requesting the adjudicatory hearing and shall state with particularity the objections to the determination, the basis therefor and the modification requested.

(b) Whenever a written request satisfying the requirements of paragraph (a) of this section has been received and the Administrator or Regional Administrator, as the case may be, determines that an adjudicatory hearing is warranted, the Administrator or the Regional Administrator, as the case may be, will set a time and place for an adjudicatory hearing in accordance with § 222.5, and will give notice of such hearing by publication in accordance with § 222.3.

(c) Prior to the conclusion of the adjudicatory hearing and appeal process, the Administrator or the Regional Administrator, as the case may be, in his discretion may extend the duration of a previously issued permit until a final determination has been made pursuant to §§ 222.11 or 222.12.

(d) In the event the Administrator or the Regional Administrator, as the case may be, determines that a request filed pursuant to paragraph (a) of this section does not comply with the requirements of such paragraph (a) or that such request does not present substantial issues of public interest, he shall advise, in writing, the person requesting the adjudicatory hearing of his determination.

(e) Any person requesting an adjudicatory hearing or requesting admission as a party to an adjudicatory hearing shall state in his written request, and shall by filing such request consent, that he and his employees and agents shall submit themselves to direct and cross-examination at any such hearing and to the taking of an oath administered by the Presiding Officer.

§ 222.11 Conduct of adjudicatory hearings.

(a) *Parties.* Any interested person may at a reasonable time prior to the commencement of the hearing submit to the Presiding Officer a request to be admitted as a party. Such request shall be in writing and shall set forth the information which would be required to be submitted by such person if he were requesting an adjudicatory hearing. Any such request to be admitted as a party which satisfies the requirements of this paragraph (a) shall be granted and all parties shall be informed at the commencement of the adjudicatory hearing of the parties involved. Any party may be represented by counsel or other authorized representative. EPA staff representing the Administrator or Regional Administrator who took action with respect to the permit application shall be deemed a party.

(b) *Filing and service.*

(1) An original and two (2) copies of all documents or papers required or permitted to be filed shall be filed with the Presiding Officer.

(2) Copies of all documents and papers filed with the Presiding Officer shall be served upon all other parties to the adjudicatory hearing.

(c) *Consolidation.* The Administrator, or the Regional Administrator in the case of a hearing arising within his Region and for which he has been delegated authority hereunder, may, in his discretion, order consolidation of any adjudicatory hearings held pursuant to this section whenever he determines that consolidation will expedite or simplify the consideration of the issues presented. The Administrator may, in his discretion, order consolidation and designate one Region to be responsible for the conduct of any hearings held pursuant to this section which arise in different Regions whenever he determines that consolidation will expedite or simplify the consideration of the issues presented.

(d) *Pre-hearing conference.* The Presiding Officer may hold one or more pre-hearing conferences and may issue a pre-hearing order which may include without limitation, requirements with respect to any or all of the following:

(1) Stipulations and admissions;

(2) Disputed issues of fact;

(3) Disputed issues of law;

(4) Admissibility of any evidence;

(5) Hearing procedures including submission of oral or written direct testimony, conduct of cross-examination, and the opportunity for oral arguments;

(6) Any other matter which may expedite the hearing or aid in disposition of any issues raised therein.

(e) *Adjudicatory hearing procedures.*

(1) The burden of going forward with the evidence shall:

(i) In the case of any adjudicatory hearing held pursuant to § 222.10(b)(1), be on the person filing a request under § 222.10(a) as to each issue raised by the request; and

(ii) In the case of any adjudicatory hearing held pursuant to § 223.2 or pursuant to Part 226, be on the Environmental Protection Agency.

(2) The Presiding Officer shall have the duty to conduct a fair and impartial hearing, to take action to avoid unnecessary delay in the disposition of proceedings, and to maintain order. He shall have all powers necessary or appropriate to that end, including without limitation, the following:

(i) To administer oaths and affirmations;

(ii) To rule upon offers of proof and receive relevant evidence;

(iii) To regulate the course of the hearing and the conduct of the parties and their counsel;

(iv) To consider and rule upon all procedural and other motions appropriate to the proceedings; and

(v) To take any action authorized by these regulations and in conformance with law.

(3) Parties shall have the right to cross-examine a witness who appears at an adjudicatory hearing to the extent that such cross-examination is necessary or appropriate for a full disclosure of the facts. In multi-party proceedings the Presiding Officer may limit cross-examination to one party on each side if he is satisfied that the cross-examination by one party will adequately protect the interests of other parties.

(4) When a party will not be unfairly prejudiced thereby, the Presiding Officer may order all of part of the evidence to be submitted in written form.

(5) Rulings of the Presiding Officer on the admissibility of evidence, the propriety of cross-examination, and other procedural matters, shall be final and shall appear in the record.

(6) Interlocutory appeals may not be taken.

(7) Parties shall be presumed to have taken exception to an adverse ruling.

(8) The proceedings of all hearings shall be recorded by such means as the Presiding Officer may determine. The original transcript of the hearing shall be a part of the record and the sole official transcript. Copies of the transcript shall be available from the Environmental Protection Agency in accordance with 40 CFR 2.

(9) The rules of evidence shall not apply.

(f) *Decision after adjudicatory hearing.*

(1) Within 30 days after the conclusion of the adjudicatory hearing, or within such additional period as the Administrator or the Regional Administrator, as the case may be, may grant to the Presiding Officer for good cause shown, the Presiding Officer shall submit to the Administrator or the Regional Administrator, as the case may be, proposed findings of fact and conclusions of law, his recommendation with respect to any and all issues raised at the hearing, and the record of the hearing. Such findings, conclusions and recommendations shall contain a brief statement of the basis for the recommendations. Copies of the Presiding Officer's proposed findings of fact, conclusions of law and recommendations shall be provided to all parties to the adjudicatory hearing on request, without charge.

(2) Within 20 days following submission of the Presiding Officer's proposed findings of fact, conclusions of law and recommendations, any party may sub-

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…written exceptions, no more than [illegible] pages in length, to such proposed findings, conclusions and recommendations and within 30 days following the submission of the Presiding Officer's proposed findings, conclusions and recommendations any party may file written comments, no more than 30 pages in length, on another party's exceptions. Within 45 days following the submission of the Presiding Officer's proposed findings, conclusions and recommendations, the Administrator or the Regional Administrator, as the case may be, shall make a determination with respect to all issues raised at such hearing and shall affirm, reverse or modify the previous or proposed determination, as the case may be. Notice of such determination shall set forth the determination for each such issue, shall briefly state the basis therefor and shall be given by mail to all parties to the adjudicatory hearing.

§ 222.12 Appeal to Administrator.

(a) Within 10 days following receipt of the determination of the Regional Administrator pursuant to paragraph (b)(2) of § 222.11, any party to an adjudicatory hearing held in accordance with § 222.11 may appeal such determination to the Administrator by filing a written notice of appeal, or the Administrator may, on his own initiative, review any prior determination.

(b) The notice of appeal shall be no more than 40 pages in length and shall contain:

(1) The name and address of the person filing the notice of appeal;

(2) A concise statement of the facts on which the person relies and appropriate citations to the record of the adjudicatory hearing;

(3) A concise statement of the legal basis on which the person relies;

(4) A concise statement setting forth the action which the person proposes that the Administrator take; and

(5) A certificate of service of the notice of appeal on all other parties to the adjudicatory hearing.

(c) The effective date of any determination made pursuant to paragraph (b)(2) of § 222.11 may be stayed by the Administrator pending final determination by him pursuant to this section upon the filing of a notice of appeal which satisfies the requirements of paragraph (b) of this section or upon initiation by the Administrator of review of any determination in the absence of such notice of appeal.

(d) Within 20 days following the filing of a notice of appeal in accordance with this section, any party to the adjudicatory hearing may file a written memorandum, no more than 40 pages in length, in response thereto.

(e) Within 45 days following the filing of a notice of appeal in accordance with this section, the Administrator shall render his final determination with respect to all issues raised in the appeal to the Administrator and shall affirm, reverse, or modify the previous determination and briefly state the basis for his determination.

(f) In accordance with 5 U.S.C. section 704, the filing of an appeal to the Administrator pursuant to this section shall be a prerequisite to judicial review of any determination to issue, deny or impose conditions upon any permit, or to modify, revoke or suspend any permit, or to take any other enforcement action, under this Subchapter H.

§ 222.13 Computation of time.

In computing any period of time prescribed or allowed in this part, except unless otherwise provided, the day on which the designated period of time begins to run shall not be included. The last day of the period so computed is to be included unless it is a Saturday, Sunday, or a legal holiday in which the Environmental Protection Agency is not open for business, in which event the period runs until the end of the next day which is not a Saturday, Sunday, or legal holiday. Intermediate Saturdays, Sundays and legal holidays shall be excluded from the computation when the period of time prescribed or allowed is seven days or less.

PART 223—CONTENTS OF PERMITS

Sec.
223.1 Contents of permits.
223.2 Generally applicable conditions of permits.

AUTHORITY: 33 U.S.C. 1412 and 1418.

§ 223.1 Contents of permits.

Permits, other than general permits, which may be issued on forms to be published by EPA and must be displayed on the vessel engaged in dumping, will include at a minimum the following:

(a) Name of permittee;

(b) Means of conveyance and methods and procedures for disposal of material to be dumped; and, in the case of permits for the transportation of material for dumping, the port through or from which such material will be transported;

(c) A complete description, including all relevant chemical and physical properties and quantities, of the material to be dumped;

(d) The disposal site;

(e) The times at which the permitted dumping may occur;

(f) Such monitoring relevant to the assessment of the impact of permitted dumping activities on the marine environment at the disposal site as the Administrator determines is feasible; and

(g) Any other terms and conditions, including those with respect to release procedures, determined to be necessary and adequate in order to conform the permitted dumping activities to the factors set forth in Section 102(a) of the Act, and the criteria set forth in Part 227.

§ 223.2 Generally applicable conditions of permits.

(a) *Modification or revocation.* Any permit issued under this Part shall be subject to modification, or revocation in whole or in part for cause, as follows:

(1) Violation of any term or condition of the permit;

(2) Misrepresentation, inaccuracy, or failure to disclose all relevant facts in the permit application;

(3) Changed circumstances, such as changes in conditions obtaining at the designated dumping site, and newly discovered scientific data relevant to the granting of the permit;

(4) Failure to keep the records, and to notify appropriate officials of dumping activities, as specified in §§ 224.1 and 224.2.

(b) *Suspension.* In addition to the conditions of a permit imposed pursuant to paragraph (a) of this section, each permit shall be subject to suspension by the Administrator or Regional Administrator if he determines that the permitted dumping has resulted, or is resulting, in imminent and substantial harm to human health or welfare or the marine environment. Such suspension shall be effective immediately upon receipt of notification thereof by the permittee.

(c) *Hearings.* Within 30 days after receipt of notice of revocation or modification pursuant to paragraph (a) of this section, or of suspension pursuant to paragraph (b) of this section, a permittee or other interested person may request in writing a hearing on the issues raised by any such revocation or suspension. Upon receipt of any such request, the Administrator or Regional Administrator shall appoint a hearing officer to conduct an adjudicatory hearing as may be required by law and by this subchapter as now or hereafter in effect.

PART 224—RECORDS AND REPORTS REQUIRED OF OCEAN DUMPING PERMITTEES UNDER SECTION 102 OF THE ACT

Sec.
224.1 Records of permittees.
224.2 Reports.

AUTHORITY: 33 U.S.C. 1412 and 1418.

§ 224.1 Records of permittees.

Each permittee named in a special, interim, emergency or research permit under section 102 of the Act and each person availing himself of the privilege conferred by a general permit, shall maintain complete records of the following information, which will be available for inspection by the Administrator, Regional Administrator, the Commandant of the U.S. Coast Guard, or their respective designees:

(a) The physical and chemical characteristics of the material dumped pursuant to the permit;

(b) The precise times and locations of dumping;

(c) Any other information required as a condition of a permit by the Administrator or the Regional Administrator, as the case may be.

§ 224.2 Reports.

(a) *Periodic reports.* Information required to be recorded pursuant to § 224.1 shall be reported to the Administrator or the Regional Administrator, as the case may be, for the periods indicated within 30 days of the expiration of such periods:

(1) For each six-month period, if any, following the effective date of the permit;

(2) For any other period of less than six months ending on the expiration date of the permit; and

(3) As otherwise required in the conditions of the permit.

(b) *Reports of emergency dumping.* If material is dumped without a permit pursuant to paragraph (c)(4) of § 220.1, the owner or operator of the vessel or aircraft from which such dumping occurs shall as soon as feasible inform the Administrator, Regional Administrator, or the nearest Coast Guard district of the incident by radio, telephone, or telegraph and shall within 10 days file a written report with the Administrator or Regional Administrator containing the information required under § 224.1 and a complete description of the circumstances under which the dumping occurred. Such description shall explain how human life at sea was in danger and how the emergency dumping reduced that danger. If the material dumped included containers, the vessel owner or operator shall immediately request the U.S. Coast Guard to publish in the local Notice to Mariners the dumping location, the type of containers, and whether the contents are toxic or explosive. Notification shall also be given to the Food and Drug Administration, Shellfish Sanitation Branch, Washington, D.C. 20204, as soon as possible.

PART 225—CORPS OF ENGINEERS DREDGED MATERIAL PERMITS

AUTHORITY: 33 U.S.C. 1412 and 1418.

§ 225.1 General.

Applications and authorizations for Dredged Material Permits under section 103 of the Act for the transportation of dredged material for the purpose of dumping it in ocean waters will be evaluated by the U.S. Army Corps of Engineers in accordance with the criteria set forth in Part 227 and processed in accordance with 33 CFR 209.120 with special attention to § 209.120(g)(17) and 33 CFR 209.145.

§ 225.2 Review of Dredged Material Permits.

(a) The District Engineer shall send a copy of the public notice to the appropriate Regional Administrator, and set forth in writing all of the following information:

(1) The location of the proposed disposal site and its physical boundaries;

(2) A statement as to whether the site has been designated for use by the Administrator pursuant to section 102(c) of the Act;

(3) If the proposed disposal site has *not* been designated by the Administrator, a statement of the basis for the proposed determination why no previously designated site is feasible and a description of the characteristics of the proposed disposal site necessary for its designation pursuant to Part 228 of this Subchapter H;

(4) The known historical uses of the proposed disposal site;

(5) Existence and documented effects of other authorized dumpings that have been made in the dumping area (e.g., heavy metal background reading and organic carbon content);

(6) An estimate of the length of time during which disposal will continue at the proposed site;

(7) Characteristics and composition of the dredged material; and

(8) A statement concerning a preliminary determination of the need for and/or availability of an environmental impact statement.

(b) The Regional Administrator will within 15 days of the date the public notice and other information required to be submitted by paragraph (a) of § 225.2 are received by him, review the information submitted and request from the District Engineer any additional information he deems necessary or appropriate to evaluate the proposed dumping.

(c) Using the information submitted by the District Engineer, and any other information available to him, the Regional Administrator will within 15 days after receipt of all requested information, make an independent evaluation of the proposed dumping in accordance with the criteria and respond to the District Engineer pursuant to paragraphs (d) or (e) of this section. The Regional Administrator may request an extension of this 15 day period to 30 days from the District Engineer.

(d) When the Regional Administrator determines that the proposed dumping will comply with the criteria, he will so inform the District Engineer in writing.

(e) When the Regional Administrator determines that the proposed dumping will not comply with the criteria he shall so inform the District Engineer in writing. In such cases, no Dredged Material Permit for such dumping shall be issued unless and until the provisions of § 225.3 are followed and the Administrator grants a waiver of the criteria pursuant to § 225.4.

§ 225.3 Procedure for invoking economic impact.

(a) When a District Engineer's determination to issue a Dredged Material Permit for the dumping of dredged material into ocean waters has been rejected by a Regional Administrator upon application of the Criteria, the District Engineer may determine whether, under § 103(d) of the Act, there is an economically feasible alternative method or site available other than the proposed dumping in ocean waters. If the District Engineer makes any such preliminary determination that there is no economically feasible alternative method or site available, he shall so advise the Regional Administrator setting forth his reasons for such determination and shall submit a report of such determination to the Chief of Engineers in accordance with 33 CFR §§ 209.120 and 209.145.

(b) If the decision of the Chief of Engineers is that ocean dumping at the designated site is required because of the unavailability of feasible alternatives, he shall so certify and request that the Secretary of the Army seek a waiver from the Administrator of the Criteria or of the critical site designation in accordance with § 225.4.

§ 225.4 Waiver by Administrator.

The Administrator shall grant the requested waiver unless within 30 days of his receipt of the notice, certificate and request in accordance with paragraph (b) of § 225.3 he determines in accordance with this section that the proposed dumping will have an unacceptable adverse effect on municipal water supplies, shellfish beds and fishery areas (including spawning and breeding areas), wildlife, or recreational areas. Notice of the Administrator's final determination under this section shall be given to the Secretary of the Army.

PART 226—ENFORCEMENT

AUTHORITY: 33 U.S.C. 1412 and 1418.

§ 226.1 Civil penalties.

In addition to the criminal penalties provided for in section 105(b) of the Act, the Administrator or his designee may assess a civil penalty of not more than $50,000 for each violation of the Act and of this subchapter. Upon receipt of information that any person has violated any provision of the Act or of this subchapter, the Administrator or his designee will notify such person in writing of the violation with which he is charged, and will convene a hearing no sooner than 30 days after such notice, at a convenient location, before a hearing officer. Such hearing shall be conducted in accordance with the procedures of § 226.2.

§ 226.2 Enforcement hearings.

Hearings convened pursuant to § 226.1 shall be hearings on a record before a hearing officer. Parties may be represented by counsel and will have the right to submit motions, to present evidence in their own behalf, to cross-examine adverse witnesses, to be apprised of all evidence considered by the hearing officer, and to receive copies of the transcript of the proceedings. Formal rules of evidence will not apply. The hearing officer will rule on all evidentiary matters, and on all motions, which will be subject to review pursuant to § 226.3.

§ 226.3 Determinations.

Within 30 days following adjournment of the hearing, the hearing officer will in all cases make findings of facts and recommendations to the Administrator including, when appropriate, a recommended appropriate penalty, after consideration of the gravity of the violation, prior violations by the person charged,

and the demonstrated good faith by such person in attempting to achieve rapid compliance with the provisions of the Act and this subchapter. A copy of the findings and recommendations of the hearing officer shall be provided to the person charged at the same time they are forwarded to the Administrator. Within 30 days of the date on which the hearing officer's findings and recommendations are forwarded to the Administrator, any party objecting thereto may file written exceptions with the Administrator.

§ 226.4 Final action.

A final order on a proceeding under this Part will be issued by the Administrator, or by such other person designated by the Administrator to take such final action, no sooner than 30 days following receipt of the findings and recommendations of the hearing officer. A copy of the final order will be served by registered mail (return receipt requested) on the person charged or his representative. In the event the final order assesses a penalty, it shall be payable within 60 days of the date of receipt of the final order, unless judicial review of the final order is sought by the person against whom the penalty is assessed.

PART 227—CRITERIA FOR THE EVALUATION OF PERMIT APPLICATIONS FOR OCEAN DUMPING OF MATERIALS

Subpart A—General

§ 227.1 Applicability.

(a) Section 102 of the Act requires that criteria for the issuance of ocean disposal permits be promulgated after consideration of the environmental effect of the proposed dumping operation, the need for ocean dumping, alternatives to ocean dumping, and the effect of the proposed action on esthetic, recreational and economic values and on other uses of the ocean. This Part 227 and Part 228 of this Subchapter H together constitute the criteria established pursuant to section 102 of the Act. The decision of the Administrator, Regional Administrator or the District Engineer, as the case may be, to issue or deny a permit and to impose specific conditions on any permit issued will be based on an evaluation of the permit application pursuant to the criteria set forth in this Part 227 and upon the requirements for disposal site management pursuant to the criteria set forth in Part 228 of this Subchapter H.

(b) With respect to the criteria to be used in evaluating disposal of dredged materials, this section and Subparts C, D, E, and G apply in their entirety. To determine whether the proposed dumping of dredged material complies with Subpart B, only §§ 227.4, 227.5, 227.6, 227.9, 227.10 and 227.13 apply. An applicant for a permit to dump dredged material must comply with all of Subparts C, D, E, G and applicable sections of B, to be deemed to have met the EPA criteria for dredged material dumping promulgated pursuant to section 102(a) of the Act. If, in any case, the Chief of Engineers finds that, in the disposition of dredged material, there is no economically feasible method or site available other than a dumping site, the utilization of which would result in noncompliance with the criteria established pursuant to Subpart B relating to the effects of dumping or with the restrictions established pursuant to section 102(c) of the Act relating to critical areas, he shall so certify and request that the Secretary of the Army seek a waiver from the Administrator pursuant to Part 225.

(c) The Criteria of this Part 227 are established pursuant to section 102 of the Act and apply to the evaluation of proposed dumping of materials under Title I of the Act. The Criteria of this Part 227 deal with the evaluation of proposed dumping of materials on a case-by-case basis from information supplied by the applicant or otherwise available to EPA or the Corps of Engineers concerning the characteristics of the waste and other considerations relating to the proposed dumping.

(d) After consideration of the provisions of §§ 227.28 and 227.29, no permit will be issued when the dumping would result in a violation of applicable water quality standards.

§ 227.2 Materials which satisfy the environmental impact criteria of Subpart B.

(a) If the applicant satisfactorily demonstrates that the material proposed for ocean dumping satisfies the environmental impact criteria set forth in Subpart B, a permit for ocean dumping will be issued unless:

(1) There is no need for the dumping, and alternative means of disposal are available, as determined in accordance with the criteria set forth in Subpart C; or

(2) There are unacceptable adverse effects on esthetic, recreational or economic values as determined in accordance with the criteria set forth in Subpart D; or

(3) There are unacceptable adverse effects on other uses of the ocean as determined in accordance with the criteria set forth in Subpart E.

(b) If the material proposed for ocean dumping satisfies the environmental impact criteria set forth in Subpart B, but the Administrator or the Regional Administrator, as the case may be, determines that any one of the considerations set forth in paragraphs (a) (1), (2) or (3) of this section applies, he will deny the permit application; provided however, that he may issue an interim permit for ocean dumping pursuant to paragraph (d) of § 220.3 and Subpart F of this Part 227 when he determines that:

(1) The material proposed for ocean dumping does not contain any of the materials listed in § 227.5 or listed in § 227.6, except as trace contaminants; and

(2) In accordance with Subpart C there is a need to ocean dump the material and no alternatives are available to such dumping; and

(3) The need for the dumping and the unavailability of alternatives, as determined in accordance with Subpart C, are of greater significance to the public interest than the potential for adverse effect on esthetic, recreational or economic values, or on other uses of the ocean, as determined in accordance with Subparts D and E, respectively.

§ 227.3 Materials which do not satisfy the environmental impact criteria set forth in Subpart B.

If the material proposed for ocean dumping does not satisfy the environmental impact criteria of Subpart B, the Administrator or the Regional Administrator, as the case may be, will deny the permit application; provided however, that he may issue an interim permit pursuant to paragraph (d) of § 220.3 and

Subpart F of this Part 227 when he determines that:

(a) The material proposed for dumping does not contain any of the materials listed in Section 227.6 except as trace contaminants, or any of the materials listed in § 227.5;

(b) In accordance with Subpart C there is a need to ocean dump the material; and

(c) Any one of the following factors is of greater significance to the public interest than the potential for adverse impact on the marine environment, as determined in accordance with Subpart B:

(1) The need for the dumping, as determined in accordance with Subpart C; or

(2) The adverse effects of denial of the permit on recreational or economic values as determined in accordance with Subpart D; or

(3) The adverse effects of denial of the permit on other uses of the ocean, as determined in accordance with Subpart E.

Subpart B—Environmental Impact

§ 227.4 Criteria for evaluating environmental impact.

This Subpart B sets specific environmental impact prohibitions, limits, and conditions for the dumping of materials into ocean waters. If the applicable prohibitions, limits, and conditions are satisfied, it is the determination of EPA that the proposed disposal will not unduly degrade or endanger the marine environment and that the disposal will present:

(a) No unacceptable adverse effects on human health and no significant damage to the resources of the marine environment;

(b) No unacceptable adverse effect on the marine ecosystem;

(c) No unacceptable adverse persistent or permanent effects due to the dumping of the particular volumes or concentrations of these materials; and

(d) No unacceptable adverse effect on the ocean for other uses as a result of direct environmental impact.

§ 227.5 Prohibited materials.

The ocean dumping of the following materials will not be approved by EPA or the Corps of Engineers under any circumstances:

(a) High-level radioactive wastes as defined in § 227.30;

(b) Materials in whatever form (including without limitation, solids, liquids, semi-liquids, gases or organisms) produced or used for radiological, chemical or biological warfare;

(c) Materials insufficiently described by the applicant in terms of their compositions and properties to permit application of the environmental impact criteria of this Subpart B;

(d) Persistent inert synthetic or natural materials which may float or remain in suspension in the ocean in such a manner that they may interfere materially with fishing, navigation, or other legitimate uses of the ocean.

§ 227.6 Constituents prohibited as other than trace contaminants.

(a) Subject to the exclusions of paragraphs (f), (g) and (h) of this section, the ocean dumping, or transportation for dumping, of materials containing the following constituents as other than trace contaminants will not be approved on other than an emergency basis:

(1) Organohalogen compounds;

(2) Mercury and mercury compounds;

(3) Cadmium and cadmium compounds;

(4) Oil of any kind or in any form, including but not limited to petroleum, oil sludge, oil refuse, crude oil, fuel oil, heavy diesel oil, lubricating oils, hydraulic fluids, and any mixtures containing these, transported for the purpose of dumping insofar as these are not regulated under the FWPCA;

(5) Known carcinogens, mutagens, or teratogens or materials suspected to be carcinogens, mutagens, or teratogens by responsible scientific opinion.

(b) These constituents will be considered to be present as trace contaminants only when they are present in materials otherwise acceptable for ocean dumping in such forms and amounts in liquid, suspended particulate, and solid phases that the dumping of the materials will not cause significant undesirable effects, including the possibility of danger associated with their bioaccumulation in marine organisms.

(c) The potential for significant undesirable effects due to the presence of these constituents shall be determined by application of results of bioassays on liquid, suspended particulate, and solid phases of wastes according to procedures acceptable to EPA, and for dredged material, acceptable to EPA and the Corps of Engineers. Materials shall be deemed environmentally acceptable for ocean dumping only when the following conditions are met:

(1) The liquid phase does not contain any of these constituents in concentrations which will exceed applicable marine water quality criteria after allowance for initial mixing; provided that mercury concentrations in the disposal site, after allowance for initial mixing, may exceed the average normal ambient concentrations of mercury in ocean waters at or near the dumping site which would be present in the absence of dumping, by not more than 50 percent; and

(2) Bioassay results on the suspended particulate phase of the waste do not indicate occurrence of significant mortality or significant adverse sublethal effects including bioaccumulation due to the dumping of wastes containing the constituents listed in paragraph (a) of this section. These bioassays shall be conducted with appropriate sensitive marine organisms as defined in § 227.27(c) using procedures for suspended particulate phase bioassays approved by EPA, or, for dredged material, approved by EPA and the Corps of Engineers. Procedures approved for bioassays under this section will require exposure of organisms for a sufficient period of time and under appropriate conditions to provide reasonable assurance, based on consideration of the statistical significance of effects at the 95 percent confidence level, that, when the materials are dumped, no significant undesirable effects will occur due either to chronic toxicity or to bioaccumulation of the constituents listed in paragraph (a) of this section; and

(3) Bioassay results on the solid phase of the wastes do not indicate occurrence of significant mortality or significant adverse sublethal effects due to the dumping of wastes containing the constituents listed in paragraph (a) of this section. These bioassays shall be conducted with sensitive benthic organisms using benthic bioassay procedures approved by EPA, or, for dredged material, approved by EPA and the Corps of Engineers. Procedures approved for bioassays under this section will require exposure of organisms for a sufficient period of time to provide reasonable assurance, based on considerations of statistical significance of effects at the 95 percent confidence level, that, when the materials are dumped, no significant undesirable effects will occur due either to chronic toxicity or to bioaccumulation of the constituents listed in paragraph (a) of this section; and

(4) For persistent organohalogens not included in the applicable marine water quality criteria, bioassay results on the liquid phase of the waste show that such compounds are not present in concentrations large enough to cause significant undesirable effects due either to chronic toxicity or to bioaccumulation in marine organisms after allowance for initial mixing.

(d) When the Administrator, Regional Administrator or District Engineer, as the case may be, has reasonable cause to believe that a material proposed for ocean dumping contains compounds identified as carcinogens, mutagens, or teratogens for which criteria have not been included in the applicable marine water quality criteria, he may require special studies to be done prior to issuance of a permit to determine the impact of disposal on human health and/or marine ecosystems. Such studies must provide information comparable to that required under paragraph (c)(3) of this section.

(e) The criteria stated in paragraphs (c) (2) and (3) of this section will become mandatory as soon as announcement of the availability of acceptable procedures is made in the FEDERAL REGISTER. At that time the interim criteria contained in paragraph (e) of this section shall no longer be applicable. As interim measures the criteria of paragraphs (c) (2) and (3) of this section may be applied on a case-by-case basis where interim guidance on acceptable bioassay procedures is provided by the Regional Administrator or, in the case of dredged material, by the District Engineer; or, in the absence of such guidance, permits may be issued for the dumping of any material only when the following conditions are met, except under an emergency permit:

(1) Mercury and its compounds are present in any solid phase of a material in concentrations less than 0.75 mg/kg,

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or less than 50 percent greater than the average total mercury content of natural sediments of similar lithologic characteristics as those at the disposal site; and

(2) Cadmium and its compounds are present in any solid phase of a material in concentrations less than 0.6 mg/kg, or less than 50 percent greater than the average total cadmium content of natural sediments of similar lithologic characteristics as those at the disposal site; and

(3) The total concentration of organohalogen constituents in the waste as transported for dumping is less than a concentration of such constituents known to be toxic to marine organisms. In calculating the concentration of organohalogens, the applicant shall consider that these constituents are all biologically available. The determination of the toxicity value will be based on existing scientific data or developed by the use of bioassays conducted in accordance with approved EPA procedures; and

(4) The total amounts of oils and greases as identified in paragraph (a) (4) of this section do not produce a visible surface sheen in an undisturbed water sample when added at a ratio of one part waste material to 100 parts of water.

(f) The prohibitions and limitations of this section do not apply to the constituents identified in paragraph (a) of this section when the applicant can demonstrate that such constituents are (1) present in the material only as chemical compounds or forms (e.g., inert insoluble solid materials) non-toxic to marine life and non-bioaccumulative in the marine environment upon disposal and thereafter, or (2) present in the material only as chemical compounds or forms which, at the time of dumping and thereafter, will be rapidly rendered non-toxic to marine life and non-bioaccumulative in the marine environment by chemical or biological degradation in the sea; provided they will not make edible marine organisms unpalatable; or will not endanger human health or that of domestic animals, fish, shellfish, or wildlife.

(g) The prohibitions and limitations of this section do not apply to the constituents identified in paragraph (a) of this section for the granting of research permits if the substances are rapidly rendered harmless by physical, chemical or biological processes in the sea; provided they will not make edible marine organisms unpalatable and will not endanger human health or that of domestic animals.

(h) The prohibitions and limitations of this section do not apply to the constituents identified in paragraph (a) of this section for the granting of permits for the transport of these substances for the purpose of incineration at sea if the applicant can demonstrate that the stack emissions consist of substances which are rapidly rendered harmless by physical, chemical or biological processes in the sea. Incinerator operations shall comply with requirements which will be established on a case-by-case basis.

§ 227.7 Limits established for specific wastes or waste constituents.

Materials containing the following constituents must meet the additional limitations specified in this section to be deemed acceptable for ocean dumping:

(a) Liquid waste constituents immiscible with or slightly soluble in seawater, such as benzene, xylene, carbon disulfide and toluene, may be dumped only when they are present in the waste in concentrations below their solubility limits in seawater. This provision does not apply to materials which may interact with ocean water to form insoluble materials;

(b) Radioactive materials, other than those prohibited by § 227.5, must be contained in accordance with the provisions of § 227.11 to prevent their direct dispersion or dilution in ocean waters;

(c) Wastes containing living organisms may not be dumped if the organisms present would endanger human health or that of domestic animals, fish, shellfish and wildlife by:

(1) Extending the range of biological pests, viruses, pathogenic microrganisms or other agents capable of infesting, infecting or extensively and permanently altering the normal populations of organisms;

(2) Degrading uninfected areas; or

(3) Introducing viable species not indigenous to an area.

(d) In the dumping of wastes of highly acidic or alkaline nature into the ocean, consideration shall be given to: (1) the effects of any change in acidity or alkalinity of the water at the disposal site; and (2) the potential for synergistic effects or for the formation of toxic compounds at or near the disposal site. Allowance may be made in the permit conditions for the capability of ocean waters to neutralize acid or alkaline wastes; provided, however, that dumping conditions must be such that the average total alkalinity or total acidity of the ocean water after allowance for initial mixing, as defined in § 227.29, may be changed, based on stoichiometric calculations, by no more than 10 per cent during all dumping operations at a site to neutralize acid or alkaline wastes.

(e) Wastes containing biodegradable constituents, or constituents which consume oxygen in any fashion, may be dumped in the ocean only under conditions in which the dissolved oxygen after allowance for initial mixing, as defined in § 227.29, will not be depressed by more than 25 per cent below the normally anticipated ambient conditions in the disposal area at the time of dumping.

§ 227.8 Limitations on the disposal rates of toxic wastes.

No wastes will be deemed acceptable for ocean dumping unless such wastes can be dumped so as not to exceed the limiting permissible concentration as defined in § 227.27; provided that this § 227.8 does not apply to those wastes for which specific criteria are established in § 227.11 or 227.12. Total quantities of wastes dumped at a site may be limited as described in § 228.8.

§ 227.9 Limitations on quantities of waste materials.

Substances which may damage the ocean environment due to the quantities in which they are dumped, or which may seriously reduce amenities, may be dumped only when the quantities to be dumped at a single time and place are controlled to prevent long-term damage to the environment or to amenities.

§ 227.10 Hazards to fishing, navigation, shorelines or beaches.

(a) Wastes which may present a serious obstacle to fishing or navigation may be dumped only at disposal sites and under conditions which will ensure no unacceptable interference with fishing or navigation.

(b) Wastes which may present a hazard to shorelines or beaches may be dumped only at sites and under conditions which will insure no unacceptable danger to shorelines or beaches.

§ 227.11 Containerized wastes.

(a) Wastes containerized solely for transport to the dumping site and expected to rupture or leak on impact or shortly thereafter must meet the appropriate requirements of §§ 227.6, 227.7, 227.8, 227.9 and 227.10.

(b) Other containerized wastes will be approved for dumping only under the following conditions:

(1) The materials to be disposed of decay, decompose or radiodecay to environmentally innocuous materials within the life expectancy of the containers and/or their inert matrix; and

(2) Materials to be dumped are present in such quantities and are of such nature that only short-term localized adverse effects will occur should the containers rupture at any time; and

(3) Containers are dumped at depths and locations where they will cause no threat to navigation, fishing, shorelines, or beaches.

§ 227.12 Insoluble wastes.

(a) Solid wastes consisting of inert natural minerals or materials compatible with the ocean environment may be generally approved for ocean dumping provided they are insoluble above the applicable trace or limiting permissible concentrations and are rapidly and completely settleable, and they are of a particle size and density that they would be deposited or rapidly dispersed without damage to benthic, demersal, or pelagic biota.

(b) Persistent inert synthetic or natural materials which may float or remain in suspension in the ocean as prohibited in paragraph (d) of § 227.5 may be dumped in the ocean only when they have been processed in such a fashion that they will sink to the bottom and remain in place.

§ 227.13 Dredged materials.

(a) Dredged materials are bottom sediments or materials that have been dredged or excavated from the navigable waters of the United States, and their

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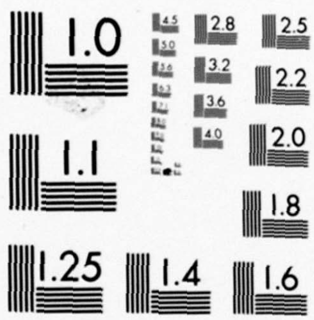

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disposal into ocean waters is regulated by the U.S. Army Corps of Engineers using the criteria of applicable sections of Parts 227 and 228. Dredged material consists primarily of natural sediments or materials which may be contaminated by municipal or industrial wastes or by runoff from terrestrial sources such as agricultural lands.

(b) Dredged material which meets the criteria set forth in the following paragraphs (1), (2), or (3) is environmentally acceptable for ocean dumping without further testing under this section:

(1) Dredged material is composed predominantly of sand, gravel, rock, or any other naturally occurring bottom material with particle sizes larger than silt, and the material is found in areas of high current or wave energy such as streams with large bed loads or coastal areas with shifting bars and channels; or

(2) Dredged material is for beach nourishment or restoration and is composed predominantly of sand, gravel or shell with particle sizes compatible with material on the receiving beaches; or

(3) When: (i) The material proposed for dumping is substantially the same as the substrate at the proposed disposal site; and

(ii) The site from which the material proposed for dumping is to be taken is far removed from known existing and historical sources of pollution so as to provide reasonable assurance that such material has not been contaminated by such pollution.

(c) When dredged material proposed for ocean dumping does not meet the criteria of paragraph (b) of this section, further testing of the liquid, suspended particulate, and solid phases, as defined in § 227.32, is required. Based on the results of such testing, dredged material can be considered to be environmentally acceptable for ocean dumping only under the following conditions:

(1) The material is in compliance with the requirements of § 227.6; and

(2) (i) All major constituents of the liquid phase are in compliance with the applicable marine water quality criteria after allowance for initial mixing; or

(ii) When the liquid phase contains major constituents not included in the applicable marine water quality criteria, or there is reason to suspect synergistic effects of certain contaminants, bioassays on the liquid phase of the dredged material show that it can be discharged so as not to exceed the limiting permissible concentration as defined in paragraph (a) of § 227.27; and

(3) Bioassays on the suspended particulate and solid phases show that it can be discharged so as not to exceed the limiting permissible concentration as defined in paragraph (b) of § 227.27.

(d) For the purposes of paragraph (c)(2), major constituents to be analyzed in the liquid phase are those deemed critical by the District Engineer, after evaluating and considering any comments received from the Regional Administrator, and considering known sources of discharges in the area.

Subpart C—Need for Ocean Dumping

§ 227.14 Criteria for evaluating the need for ocean dumping and alternatives to ocean dumping.

This Subpart C states the basis on which an evaluation will be made of the need for ocean dumping, and alternatives to ocean dumping. The nature of these factors does not permit the promulgation of specific quantitative criteria of each permit application. These factors will therefore be evaluated if applicable for each proposed dumping on an individual basis using the guidelines specified in this Subpart C.

§ 227.15 Factors considered.

The need for dumping will be determined by evaluation of the following factors:

(a) Degree of treatment useful and feasible for the waste to be dumped, and whether or not the waste material has been or will be treated to this degree before dumping;

(b) Raw materials and manufacturing or other processes resulting in the waste, and whether or not these materials or processes are essential to the provision of the applicant's goods or services, or if other less polluting materials or processes could be used;

(c) The relative environmental risks, impact and cost for ocean dumping as opposed to other feasible alternatives including but not limited to:

(1) Land fill;
(2) Well injection;
(3) Incineration;
(4) Spread of material over open ground;
(5) Recycling of material for reuse;
(6) Additional biological, chemical, or physical treatment of intermediate or final waste streams;
(7) Storage.

(d) Irreversible or irretrievable consequences of the use of alternatives to ocean dumping.

§ 227.16 Basis for determination of need for ocean dumping.

(a) A need for ocean dumping will be considered to have been demonstrated when a thorough evaluation of the factors listed in § 227.15 has been made, and the Administrator, Regional Administrator or District Engineer, as the case may be, has determined that the following conditions exist where applicable:

(1) There are no practicable improvements which can be made in process technology or in overall waste treatment to reduce the adverse impacts of the waste on the total environment;

(2) There are no practicable alternative locations and methods of disposal or recycling available, including without limitation, storage until treatment facilities are completed, which have less adverse environmental impact or potential risk to other parts of the environment than ocean dumping.

(b) For purposes of paragraph (a) of this section, waste treatment or improvements in processes and alternative methods of disposal are practicable when they are available at reasonable incremental cost and energy expenditures, which need not be competitive with the costs of ocean dumping, taking into account the environmental benefits derived from such activity, including the relative adverse environmental impacts associated with the use of alternatives to ocean dumping.

(c) The duration of permits issued under Subchapter H and other terms and conditions imposed in those permits shall be determined after taking into account the factors set forth in this section. Notwithstanding compliance with Subparts B, D, and E of this Part 227 permittees may, on the basis of the need for and alternatives to ocean dumping, be required to terminate all ocean dumping by a specified date, to phase out all ocean dumping over a specified period or periods, to continue research and development of alternative methods of disposal and make periodic reports of such research and development in order to provide additional information for periodic review of the need for and alternatives to ocean dumping, or to take such other action as the Administrator, the Regional Administrator, or District Engineer, as the case may be, determines to be necessary or appropriate.

Subpart D—Impact of the Proposed Dumping on Esthetic, Recreational and Economic Values

§ 227.17 Basis for determination.

(a) The impact of dumping on esthetic, recreational and economic values will be evaluated on an individual basis using the following considerations:

(1) potential for affecting recreational use and values of ocean waters, inshore waters, beaches, or shorelines;

(2) potential for affecting the recreational and commercial values of living marine resources.

(b) For all proposed dumping, full consideration will be given to such nonquantifiable aspects of esthetic, recreational and economic impact as:

(1) responsible public concern for the consequences of the proposed dumping;

(2) consequences of not authorizing the dumping including without limitation, the impact on esthetic, recreational and economic values with respect to the municipalities and industries involved.

§ 227.18 Factors considered.

The assessment of the potential for impacts on esthetic, recreational and economic values will be based on an evaluation of the appropriate characteristics of the material to be dumped, allowing for conservative rates of dilution, dispersion, and biochemical degradation during movement of the materials from a disposal site to an area of significant recreational or commercial value. The following specific factors will be considered in making such an assessment:

(a) Nature and extent of present and potential recreational and commercial use of areas which might be affected by the proposed dumping;

(b) Existing water quality, and nature and extent of disposal activities, in the areas which might be affected by the proposed dumping;

(c) Applicable water quality standards;

(d) Visible characteristics of the materials (e.g., color, suspended particulates) which result in an unacceptable esthetic nuisance in recreational areas;

(e) Presence in the material of pathogenic organisms which may cause a public health hazard either directly or through contamination of fisheries or shellfisheries;

(f) Presence in the material of toxic chemical constituents released in volumes which may affect humans directly;

(g) Presence in the material of chemical constituents which may be bioaccumulated or persistent and may have an adverse effect on humans directly or through food chain interactions;

(h) Presence in the material of any constituents which might significantly affect living marine resources of recreational or commercial value.

§ 227.19 Assessment of impact.

An overall assessment of the proposed dumping and possible alternative methods of disposal or recycling will be made based on the effect on esthetic, recreational and economic values based on the factors set forth in this Subpart D, including where applicable, enhancement of these values, and the results of the assessment will be expressed, where possible, on a quantitative basis, such as percentage of a resource lost, reduction in user days of recreational areas, or dollars lost in commercial fishery profits or the profitability of other commercial enterprises.

Subpart E—Impact of the Proposed Dumping on Other Uses of the Ocean

§ 227.20 Basis for determination.

(a) Based on current state-of-the-art, consideration must be given to any possible long-range effects of even the most innocuous substances when dumped in the ocean on a continuing basis. Such a consideration is made in evaluating the relationship of each proposed disposal activity in relationship to its potential for long-range impact on other uses of the ocean.

(b) An evaluation will be made on an individual basis for each proposed dumping of material of the potential for effects on uses of the ocean for purposes other than material disposal. The factors to be considered in this evaluation include those stated in Subpart D, but the evaluation of this Subpart E will be based on the impact of the proposed dumping on specific uses of the ocean rather than on overall esthetic, recreational and economic values.

§ 227.21 Uses considered.

An appraisal will be made of the nature and extent of existing and potential uses of the disposal site itself and of any areas which might reasonably be expected to be affected by the proposed dumping, and a quantitative and qualitative evaluation made, where feasible, of the impact of the proposed dumping on each use. The uses considered shall include, but not be limited to:

(a) Commercial fishing in open ocean areas;

(b) Commercial fishing in coastal areas;

(c) Commercial fishing in estuarine areas;

(d) Recreational fishing in open ocean areas;

(e) Recreational fishing in coastal areas;

(f) Recreational fishing in estuarine areas;

(g) Recreational use of shorelines and beaches;

(h) Commercial navigation;

(i) Recreational navigation;

(j) Actual or anticipated exploitation of living marine resources;

(k) Actual or anticipated exploitation of non-living resources, including without limitation, sand and gravel places and other mineral deposits, oil and gas exploration and development and offshore marine terminal or other structure development; and

(l) Scientific research and study.

§ 227.22 Assessment of impact.

The assessment of impact on other uses of the ocean will consider both temporary and long-range effects within the state of the art, but particular emphasis will be placed on any irreversible or irretrievable commitment of resources that would result from the proposed dumping.

Subpart F—Special Requirements for Interim Permits Under Section 102 of the Act

§ 227.23 General requirement.

Each interim permit issued under section 102 of the Act will include a requirement for the development and implementation, as soon as practicable, of a plan which requires, at the discretion of the Administrator or Regional Administrator, as the case may be, either:

(a) Elimination of ocean disposal of the waste, or

(b) Bringing the waste into compliance with all the criteria for acceptable ocean disposal.

§ 227.24 Contents of environmental assessment.

A plan developed pursuant to this Subpart F must include an environmental assessment of the proposed action, including without limitation:

(a) Description of the proposed action;

(b) A thorough review of the actual need for dumping;

(c) Environmental impact of the proposed action;

(d) Adverse impacts which cannot be avoided should the proposal be implemented;

(e) Alternatives to the proposed action;

(f) Relationship between short-term uses of man's environment and the maintenance and enhancement of long-term productivity;

(g) Irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented; and

(h) A discussion of problems and objections raised by other Federal, State and local agencies and by interested persons in the review process.

§ 227.25 Contents of plans.

In addition to the environmental assessment required by § 227.24, a plan developed pursuant to this Subpart F must include a schedule for eliminating ocean dumping or bringing the wastes into compliance with the environmental impact criteria of Subpart B, including without limitation, the following:

(a) If the waste is treated to the degree necessary to bring it into compliance with the ocean dumping criteria, the applicant should provide a description of the treatment and a scheduled program for treatment and a subsequent analysis of treated material to prove the effectiveness of the process.

(b) If treatment cannot be effected by post-process techniques the applicant should, determining the offending constituents, examine his raw materials and his total process to determine the origin of the pollutant. If the offending constituents are found in the raw material the applicant should consider a new supplier and provide an analysis of the new material to prove compliance. Raw materials are to include all water used in the process. Water from municipal sources complying with drinking water standards is acceptable. Water from other sources such as private wells should be analyzed for contaminants. Water that has been used in the process should be considered for treatment and recycling as an additional source of process water.

(c) If offending constituents are a result of the process, the applicant should investigate and describe the source of the constituents. A report of this information will be submitted to EPA and the applicant will then submit a proposal describing possible alternatives to the existing process or processes and level of cost and effectiveness.

(d) If an acceptable alternative to ocean dumping or additional control technology is required, a schedule and documentation for implementation of the alternative or approved control process shall be submitted and shall include, without limitation:

(1) Engineering plan;
(2) Financing approval;
(3) Starting date for change;
(4) Completion date;
(5) Operation starting date.

(e) If an acceptable alternative does not exist at the time the application is submitted, the applicant will submit an acceptable in-house research program or employ a competent research institution to study the problem. The program of research must be approved by the Administrator or Regional Administrator, as the case may be, before the initiation

of the research. The schedule and documentation for implementation of a research program will include, without limitation:

(1) Approaches;
(2) Experimental design;
(3) Starting date;
(4) Reporting intervals;
(5) Proposed completion date;
(6) Date for submission of final report.

§ 227.26 Implementation of plans.

Implementation of each phase of a plan shall be initiated as soon as it is approved by the Administrator or Regional Administrator, as the case may be.

Subpart G—Definitions

§ 227.27 Limiting permissible concentration (LPC).

(a) The limiting permissible concentration of the liquid phase of a material is:

(1) That concentration of a constituent which, after allowance for initial mixing as provided in § 227.29, does not exceed applicable marine water quality criteria; or, when there are no applicable marine water quality criteria,

(2) That concentration of waste or dredged material in the receiving water which, after allowance for initial mixing, as specified in § 227.29, will not exceed a toxicity threshold defined as 0.01 of a concentration shown to be acutely toxic to appropriate sensitive marine organisms in a bioassay carried out in accordance with approved EPA procedures.

(3) When there is reasonable scientific evidence on a specific waste material to justify the use of an application factor other than 0.01 as specified in paragraph (a)(2) of this section, such alternative application factor shall be used in calculating the LPC.

(b) The limiting permissible concentration of the suspended particulate and solid phases of a material means that concentration which will not cause unreasonable acute or chronic toxicity or other sublethal adverse effects based on bioassay results using appropriate sensitive marine organisms in the case of the suspended particulate phase, or appropriate sensitive benthic marine organisms in the case of the solid phase; or which will not cause accumulation of toxic materials in the human food chain. These bioassays are to be conducted in accordance with procedures approved by EPA, or, in the case of dredged material, approved by EPA and the Corps of Engineers.[1]

(c) "Appropriate sensitive marine organisms" means at least one species each representative of phytoplankton or zooplankton, crustacean or mollusk, and fish species chosen from among the most sensitive species documented in the scientific literature or accepted by EPA as being reliable test organisms to determine the anticipated impact of the wastes on the ecosystem at the disposal site. Bioassays, except on phytoplankton or zooplankton, shall be run for a minimum of 96 hours under temperature, salinity, and dissolved oxygen conditions representing the extremes of environmental stress at the disposal site. Bioassays on phytoplankton or zooplankton may be run for shorter periods of time as appropriate for the organisms tested at the discretion of EPA, or EPA and the Corps of Engineers, as the case may be.

(d) "Appropriate sensitive benthic marine organisms" means at least one species each representing filter-feeding, deposit-feeding, and burrowing species chosen from among the most sensitive species accepted by EPA as being reliable test organisms to determine the anticipated impact on the site; provided, however, that until sufficient species are adequately tested and documented, interim guidance on appropriate organisms available for use will be provided by the Administrator, Regional Administrator, or the District Engineer, as the case may be.

§ 227.28 Release zone.

The release zone is the area swept out by the locus of points constantly 100 meters from the perimeter of the conveyance engaged in dumping activities, beginning at the first moment in which dumping is scheduled to occur and ending at the last moment in which dumping is scheduled to occur. No release zone shall exceed the total surface area of the dumpsite.

§ 227.29 Initial mixing.

(a) Initial mixing is defined to be that dispersion or diffusion of liquid, suspended particulate, and solid phases of a waste which occurs within four hours after dumping. The limiting permissible concentration shall not be exceeded beyond the boundaries of the disposal site during initial mixing, and shall not be exceeded at any point in the marine environment after initial mixing. The maximum concentration of the liquid, suspended particulate, and solid phases of a dumped material after initial mixing shall be estimated by one of these methods, in order of preference:

(1) When field data on the proposed dumping are adequate to predict initial dispersion and diffusion of the waste, these shall be used, if necessary, in conjunction with an appropriate mathematical model acceptable to EPA or the District Engineer, as appropriate.

(2) When field data on the dispersion and diffusion of a waste of characteristics similar to that proposed for discharge are available, these shall be used in conjunction with an appropriate mathematical model acceptable to EPA or the District Engineer, as appropriate.

(3) When no field data are available, theoretical oceanic turbulent diffusion relationships may be applied to known characteristics of the waste and the disposal site.

(b) When no other means of estimation are feasible,

(1) The liquid and suspended particulate phases of the dumped waste may be assumed to be evenly distributed after four hours over a column of water bounded on the surface by the release zone and extending to the ocean floor, thermocline, or halocline if one exists, or to a depth of 20 meters, whichever is shallower, and

(2) The solid phase of a dumped waste may be assumed to settle rapidly to the ocean bottom and to be distributed evenly over the ocean bottom in an area equal to that of the release zone as defined in § 227.28.

(c) When there is reasonable scientific evidence to demonstrate that other methods of estimating a reasonable allowance for initial mixing are appropriate for a specific material, such methods may be used with the concurrence of EPA after appropriate scientific review.

§ 227.30 High-level radioactive waste.

High-level radioactive waste means the aqueous waste resulting from the operation of the first cycle solvent extraction system, or equivalent, and the concentrated waste from subsequent extraction cycles, or equivalent, in a facility for reprocessing irradiated reactor fuels or irradiated fuel from nuclear power reactors.

§ 227.31 Applicable marine water quality criteria.

Applicable marine water quality criteria means the criteria given for marine waters in the EPA publication "Quality Criteria for Water" as published in 1976 and amended by subsequent supplements or additions.

§ 227.32 Liquid, suspended particulate, and solid phases of a material.

(a) For the purposes of these regulations, the liquid phase of a material, subject to the exclusions of paragraph (b) of this section, is the supernatant remaining after one hour undisturbed settling, after centrifugation and filtration through a 0.45 micron filter. The suspended particulate phase is the supernatant as obtained above prior to centrifugation and filtration. The solid phase includes all material settling to the bottom in one hour. Settling shall be conducted according to procedures approved by EPA.

(b) For dredged material, other material containing large proportions of insoluble matter, materials which may interact with ocean water to form insoluble matter or new toxic compounds, or materials which may release toxic compounds upon deposition, the Administrator, Regional Administrator, or the District Engineer, as the case may be, may require that the separation of liquid, suspended particulate, and solid phases of the material be performed upon a mixture of the waste with ocean water rather than on the material itself. In

[1] An implementation manual is being developed jointly by EPA and the Corps of Engineers, and announcement of the availability of the manual will be published in the FEDERAL REGISTER. Until this manual is available, interim guidance on the appropriate procedures can be obtained from the Marine Protection Branch, WH-548, Environmental Protection Agency, 401 M Street SW, Washington, DC 20460, or the Corps of Engineers, as the case may be.

such cases the following procedures shall be used:

(1) For dredged material, the liquid phase is considered to be the centrifuged and 0.45 micron filtered supernatant remaining after one hour undisturbed settling of the mixture resulting from a vigorous 30-minute agitation of one part bottom sediment from the dredging site with four parts water (vol/vol) collected from the dredging site or from the disposal site, as appropriate for the type of dredging operation. The suspended particulate phase is the supernatant as obtained above prior to centrifugation and filtration. The solid phase is considered to be all material settling to the bottom within one hour. Settling shall be conducted by procedures approved by EPA and the Corps of Engineers.

(2) For other materials, the proportion of ocean water used shall be the minimum amount necessary to produce the anticipated effect (e.g., complete neutralization of an acid or alkaline waste) based on guidance provided by EPA on particular cases, or in accordance with approved EPA procedures. For such materials the liquid phase is the filtered and centrifuged supernatant resulting from the mixture after 30 minutes of vigorous shaking followed by undisturbed settling for one hour. The suspended particulate phase is the supernatant as obtained above prior to centrifugation and filtration. The solid phase is the insoluble material settling to the bottom in that period.

PART 228—CRITERIA FOR THE MANAGEMENT OF DISPOSAL SITES FOR OCEAN DUMPING

AUTHORITY: 33 U.S.C. 1412 and 1418.

§ 228.1 Applicability.

The criteria of this Part 228 are established pursuant to section 102 of the Act and apply to the evaluation of proposed ocean dumping under Title I of the Act. The criteria of this Part 228 deal with the evaluation of the proposed dumping of material in ocean waters in relation to continuing requirements for effective management of ocean disposal sites to prevent unreasonable degradation of the marine environment from all wastes being dumped in the ocean. This Part 228 is applicable to dredged material disposal sites only as specified in §§ 228.4(*e*), 228.9, and 228.12.

§ 228.2 Definitions.

(a) The term "disposal site" means an interim or finally approved and precise geographical area within which ocean dumping of wastes is permitted under conditions specified in permits issued under sections 102 and 103 of the Act. Such sites are identified by boundaries established by (1) coordinates of latitude and longitude for each corner, or by (2) coordinates of latitude and longitude for the center point and a radius in nautical miles from that point. Boundary coordinates shall be identified as precisely as is warranted by the accuracy with which the site can be located with existing navigational aids or by the implantation of transponders, buoys or other means of marking the site.

(b) The term "baseline" or "trend assessment" survey means the planned sampling or measurement of parameters at set stations or in set areas in and near disposal sites for a period of time sufficient to provide synoptic data for determining water quality, benthic, or biological conditions as a result of ocean disposal operations. The minimum requirements for such surveys are given in § 228.13.

(c) The term "disposal site evaluation study" means the collection, analysis, and interpretation of all pertinent information available concerning an existing disposal site, including but not limited to, data and information from trend assessment surveys, monitoring surveys, special purpose surveys of other Federal agencies, public data archives, and social and economic studies and records of affected areas.

(d) The term "disposal site designation study" means the collection, analysis and interpretation of all available pertinent data and information on a proposed disposal site prior to use, including but not limited to, that from baseline surveys, special purpose surveys of other Federal agencies, public data archives, and social and economic studies and records of areas which would be affected by use of the proposed site.

(e) The term "management authority" means the EPA organizational entity assigned responsibility for implementing the management functions identified in § 228.3.

(f) "Statistical significance" shall mean the statistical significance determined by using appropriate standard techniques of multivariate analysis with results interpreted at the 95 percent confidence level and based on data relating species which are present in sufficient numbers at control areas to permit a valid statistical comparison with the areas being tested.

(g) "Valuable commercial and recreational species" shall mean those species for which catch statistics are compiled on a routine basis by the Federal or State agency responsible for compiling such statistics for the general geographical area impacted, or which are under current study by such Federal or State agencies for potential development for commercial or recreational use.

(h) "Normal ambient value" means that concentration of a chemical species reasonably anticipated to be present in the water column, sediments, or biota in the absence of disposal activities at the disposal site in question.

§ 228.3 Disposal site management responsibilities.

Management of a site consists of regulating times, rates, and methods of disposal and quantities and types of materials disposed of; developing and maintaining effective ambient monitoring programs for the site; conducting disposal site evaluation and designation studies; and recommending modifications in site use and/or designation (e.g., termination of use of the site for general use or for disposal of specific wastes).

Each site, upon interim or continuing use designation, will be assigned to either an EPA Regional office or to EPA Headquarters for management. These designations will be consistent with the delegation of authority in § 220.4. The designated management authority is fully responsible for all aspects of the management of sites within the general requirements specified in § 220.4 and this section. Specific requirements for meeting the management responsibilities assigned to the designated management authority for each site are outlined in §§ 228.5 and 228.6.

§ 228.4 Procedures for designation of sites.

(a) *General Permits.* Geographical areas or regions within which materials may be dumped under a general permit will be published as part of the promulgation of each general permit.

(b) *Special and Interim Permits.* Areas where ocean dumping is permitted subject to the specific conditions of individual special or interim permits, will be designated by promulgation in this Part 228, and such designation will be made based on environmental studies of each site, regions adjacent to the site, and on historical knowledge of the impact of waste disposal on areas similar to such sites in physical, chemical, and biological characteristics. All studies for the evaluation and potential selection of dumping sites will be conducted in accordance with the requirements of §§ 228.5 and 228.6.

The Administrator may, from time to time, designate specific locations for temporary use for disposal of small amounts of materials under a special permit only without disposal site designation studies when such materials satisfy the Criteria and the Administrator determines that the quantities to be disposed of at such sites will not result in significant impact on the environment. Such designations will be done by promulgation in this Part 228, and will be for a specified period of time and for specified quantities of materials.

(c) *Emergency Permits.* Dumping sites for materials disposed of under an emergency permit will be specified by the Administrator as a permit condition and will be based on an individual appraisal

of the characteristics of the waste and the safest means for its disposal.

(d) *Research Permits.* Dumping sites for research permits will be determined by the nature of the proposed study. Dumping sites will be specified by the Administrator as a permit condition.

(e) *Dredged Material Permits.*

(1) Areas where ocean dumping of dredged material is permitted subject to the specific conditions of Dredged Material permits issued by the U.S. Army Corps of Engineers will be designated by EPA by promulgation in this Part 228, and such designation will be made based on environmental studies of each site, regions adjacent to the site, and on historical knowledge of the impact of dredged material disposal on areas similar to such sites in physical, chemical, and biological characteristics. All studies for the evaluation and potential selection of dredged material disposal sites will be conducted in accordance with the appropriate requirements of §§ 228.5 and 228.6, except that:

(i) *Baseline or trend assessment requirements* may be developed on a case-by-case basis from the results of research, including that now in progress by the Corps of Engineers.

(ii) An environmental impact assessment for all sites within a particular geographic area may be prepared based on complete disposal site designation or evaluation studies on a typical site or sites in that area. In such cases, sufficient studies to demonstrate the generic similarity of all sites within such a geographic area will be conducted.

(2) In those cases where a recommended disposal site has not been designated by the Administrator, or where it is not feasible to utilize a recommended disposal site that has been designated by the Administrator, the District Engineer shall, in consultation with EPA, select a site in accordance with the requirements of §§ 228.5 and 228.6(a). Concurrence by EPA in permits issued for the use of such site for the dumping of dredged material at the site will constitute EPA approval of the use of the site for dredged material disposal only.

(3) Sites designated for the ocean dumping of dredged material in accordance with the procedures of paragraphs (e)(1) or (e)(2) of this section shall be used only for the ocean dumping of dredged material under permits issued by the U.S. Army Corps of Engineers.

§ 228.5 General criteria for the selection of sites.

(a) The dumping of materials into the ocean will be permitted only at sites or in areas selected to minimize the interference of disposal activities with other activities in the marine environment, particularly avoiding areas of existing fisheries or shellfisheries, and regions of heavy commercial or recreational navigation.

(b) Locations and boundaries of disposal sites will be so chosen that temporary perturbations in water quality or other environmental conditions during initial mixing caused by disposal operations anywhere within the site can be expected to be reduced to normal ambient seawater levels or to undetectable contaminant concentrations or effects before reaching any beach, shoreline, marine sanctuary, or known geographically limited fishery or shellfishery.

(c) If at anytime during or after disposal site evaluation studies, it is determined that existing disposal sites presently approved on an interim basis for ocean dumping do not meet the criteria for site selection set forth in §§ 228.5–228.6, the use of such sites will be terminated as soon as suitable alternate disposal sites can be designated.

(d) The sizes of ocean disposal sites will be limited in order to localize for identification and control any immediate adverse impacts and permit the implementation of effective monitoring and surveillance programs to prevent adverse long-range impacts. The size, configuration, and location of any disposal site will be determined as a part of the disposal site evaluation or designation study.

(e) EPA will, wherever feasible, designate ocean dumping sites beyond the edge of the continental shelf and other such sites that have been historically used.

§ 228.6 Specific criteria for site selection.

(a) In the selection of disposal sites, in addition to other necessary or appropriate factors determined by the Administrator, the following factors will be considered:

(1) Geographical position, depth of water, bottom topography and distance from coast;

(2) Location in relation to breeding, spawning, nursery, feeding, or passage areas of living resources in adult or juvenile phases;

(3) Location in relation to beaches and other amenity areas;

(4) Types and quantities of wastes proposed to be disposed of, and proposed methods of release, including methods of packing the waste, if any;

(5) Feasibility of surveillance and monitoring;

(6) Dispersal, horizontal transport and vertical mixing characteristics of the area, including prevailing current direction and velocity, if any;

(7) Existence and effects of current and previous discharges and dumping in the area (including cumulative effects);

(8) Interference with shipping, fishing, recreation, mineral extraction, desalination, fish and shellfish culture, areas of special scientific importance and other legitimate uses of the ocean;

(9) The existing water quality and ecology of the site as determined by available data or by trend assessment or baseline surveys;

(10) Potentiality for the development or recruitment of nuisance species in the disposal site;

(11) Existence at or in close proximity to the site of any significant natural or cultural features of historical importance.

(b) The results of a disposal site evaluation and/or designation study based on the criteria stated in paragraphs (1)–(11) will be presented in support of the site designation promulgation as an environmental assessment of the impact of the use of the site for disposal, and will be used in the preparation of an environmental impact statement for each site where such a statement is required by EPA policy. By publication of a notice in accordance with this Part 228, an environmental impact statement, in draft form, will be made available for public comment not later than the time of publication of the site designation as proposed rulemaking, and a final EIS will be made available at the time of final rulemaking.

§ 228.7 Regulation of disposal site use.

Where necessary, disposal site use will be regulated by setting limitations on times of dumping and rates of discharge, and establishing a disposal site monitoring program.

§ 228.8 Limitations on times and rates of disposal.

Limitations as to time for and rates of dumping may be stated as part of the promulgation of site designation. The times and the quantities of permitted material disposal will be regulated by the EPA management authority so that the limits for the site as specified in the site designation are not exceeded. This will be accomplished by the denial of permits for the disposal of some materials, by the imposition of appropriate conditions on other permits and, if necessary, the designation of new disposal sites under the procedures of § 228.4. In no case may the total volume of material disposed of at any site under special or interim permits cause the concentration of the total materials or any constituent of any of the materials being disposed of at the site to exceed limits specified in the site designation.

§ 228.9 Disposal site monitoring.

(a) The monitoring program, if deemed necessary by the Regional Administrator or the District Engineer, as appropriate, may include baseline or trend assessment surveys by EPA, NOAA, other Federal agencies, or contractors, special studies by permittees, and the analysis and interpretation of data from remote or automatic sampling and/or sensing devices. The primary purpose of the monitoring program is to evaluate the impact of disposal on the marine environment by referencing the monitoring results to a set of baseline conditions. When disposal sites are being used on a continuing basis, such programs may consist of the following components:

(1) Trend assessment surveys conducted at intervals frequent enough to assess the extent and trends of environmental impact. Until survey data or other information are adequate to show that changes in frequency or scope are necessary or desirable, trend assessment and baseline surveys should generally conform to the applicable requirements of § 228.13. These surveys shall be the responsibility of the Federal government.

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(2) Special studies conducted by the permittee to identify immediate and short-term impacts of disposal operations.

(b) These surveys may be supplemented, where feasible and useful, by data collected from the use of automatic sampling buoys, satellites or in situ platforms, and from experimental programs.

(c) EPA will require the full participation of permittees, and encourage the full participation of other Federal and State and local agencies in the development and implementation of disposal site monitoring programs. The monitoring and research programs presently supported by permittees may be incorporated into the overall monitoring program insofar as feasible.

§ 228.10 Evaluating disposal impact.

(a) Impact of the disposal at each site designated under section 102 of the Act will be evaluated periodically and a report will be submitted as appropriate as part of the Annual Report to Congress. Such reports will be prepared by or under the direction of the EPA management authority for a specific site and will be based on an evaluation of all data available from baseline and trend assessment surveys, monitoring surveys, and other data pertinent to conditions at and near a site.

(b) The following types of effects, in addition to other necessary or appropriate considerations, will be considered in determining to what extent the marine environment has been impacted by materials disposed of at an ocean disposal site:

(1) Movement of materials into estuaries or marine sanctuaries, or onto oceanfront beaches, or shorelines;

(2) Movement of materials toward productive fishery or shellfishery areas;

(3) Absence from the disposal site of pollution-sensitive biota characteristic of the general area;

(4) Progressive, non-seasonal, changes in water quality or sediment composition at the disposal site, when these changes are attributable to materials disposed of at the site;

(5) Progressive, non-seasonal, changes in composition or numbers of pelagic, demersal, or benthic biota at or near the disposal site, when these changes can be attributed to the effects of materials disposed of at the site;

(6) Accumulation of material constituents (including without limitation, human pathogens) in marine biota at or near the site.

(c) The determination of the overall severity of disposal at the site on the marine environment, including without limitation, the disposal site and adjacent areas, will be based on the evaluation of the entire body of pertinent data using appropriate methods of data analysis for the quantity and type of data available. Impacts will be categorized according to the overall condition of the environment of the disposal site and adjacent areas based on the determination by the EPA management authority assessing the nature and extent of the effects identified in paragraph (b) of this section in addition to other necessary or appropriate considerations. The following categories shall be used:

(1) *Impact Category I*: The effects of activities at the disposal site shall be categorized in Impact Category I when one or more of the following conditions is present and can reasonably be attributed to ocean dumping activities:

(i) There is identifiable progressive movement or accumulation, in detectable concentrations above normal ambient values, of any waste or waste constituent from the disposal site within 12 nautical miles of any shoreline, marine sanctuary designated under Title III of the Act, or critical area designated under section 102(c) of the Act; or

(ii) The biota, sediments, or water column of the disposal site, or of any area outside the disposal site where any waste or waste constituent from the disposal site is present in detectable concentrations above normal ambient values, are adversely affected by the toxicity of such waste or waste constituent to the extent that there are statistically significant decreases in the populations of valuable commercial or recreational species, or of specific species of biota essential to the propagation of such species, within the disposal site and such other area as compared to populations of the same organisms in comparable locations outside such site and area; or

(iii) Solid waste material disposed of at the site has accumulated at the site or in areas adjacent to it, to such an extent that major uses of the site or of adjacent areas are significantly impaired and the Federal or State agency responsible for regulating such uses certifies that such significant impairment has occurred and states in its certificate the basis for its determination of such impairment; or

(iv) There are adverse effects on the taste or odor of valuable commercial or recreational species as a result of disposal activities; or

(v) When any toxic waste, toxic waste constituent, or toxic byproduct of waste interaction, is consistently identified in toxic concentrations above normal ambient values outside the disposal site more than four hours after disposal.

(2) *Impact Category II:* The effects of activities at the disposal site which are not categorized in Impact Category I shall be categorized in Impact Category II.

§ 228.11 Modification in disposal site use.

(a) Modifications in disposal site use which involve the withdrawal of designated disposal sites from use or permanent changes in the total specified quantities or types of wastes permitted to be discharged to a specific disposal site will be made through promulgation of an amendment to the disposal site designation set forth in this Part 228 and will be based on the results of the analyses of impact described in § 228.10 or upon changed circumstances concerning use of the site.

(b) Modifications in disposal site use promulgated pursuant to paragraph (a) of this section shall not automatically modify conditions of any outstanding permit issued pursuant to this Subchapter H, and provided further that unless the EPA management authority for such site modifies, revokes or suspends such permit or any of the terms or conditions of such permit in accordance with the provisions of § 228.2 based on the results of impact analyses as described in § 228.10 or upon changed circumstances concerning use of the site, such permit will remain in force until its expiration date.

(c) When the EPA management authority determines that activities at a disposal site have placed the site in Impact Category I, the Administrator or the Regional Administrator, as the case may be, shall place such limitations on the use of the site as are necessary to reduce the impacts to acceptable levels.

(d) The determination of the Administrator as to whether to terminate or limit use of a disposal site will be based on the impact of disposal at the site itself and on the Criteria.

§ 228.12 Delegation of management authority for interim ocean dumping sites.

(a) The following sites are approved for dumping the indicated materials on an interim basis pending completion of baseline or trend assessment surveys and designation for continuing use or termination of use. Management authority for all sites is delegated to the EPA organizational entity under which each site is listed. The sizes and use specifications are based on historical usage and do not necessarily meet the criteria stated in this Part. This list of interim sites will remain in force for a period not to exceed three years from the date of final promulgation of this Part 228, except for those sites approved for continuing use or disapproved for use by promulgation in this Part during that period of time.

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Approved interim dumping sites

Location (latitude, longitude)	EPA region	Primary use
43°33'00" N., 69°55'00" W., 1 nautical mile radius	I	Industrial wastes.
42°25'42" N., 70°35'00" W., 1 nautical mile radius	I	Do.
40°22'30" N. to 40°25'00" N., 73°41'30" W. to 73°45'00" W	II	Municipal sewage sludge.
40°16'00" N. to 40°20'00" N., 73°36'00" W. to 73°40'00" W	II	Acid wastes.
38°40'00" N. to 39°00'00" N., 72°00'00" W. to 72°30'00" W	II	Industrial wastes.
40°23'00" N., 73°49'00" W., 0.6 nautical mile radius	II	Cellar dirt.
40°10'00" N., 73°42'00" W., 0.5 nautical mile radius	II	Wrecks.
19°10'00" N. to 19°20'00" N., 66°35'00" W. to 66°50'00" W	II	Industrial wastes.
38°30'00" N. to 38°35'00" N., 74°15'00" W. to 74°25'00" W	III	Acid wastes.
38°20'00" N. to 38°25'00" N., 74°10'00" W. to 74°20'00" W	III	Municipal sewage sludge.
31°46'00" N., 80°30'00" W., 31°47'06" N., 80°29'00" W., 31°48'00" N., 80°30'30" W., 31°46'30" N., 80°32'00" W.	IV	Industrial wastes.
27°12'00" N. to 27°28'00" N., 94°28'00" W. to 94°44'00" W	VI	Do.
28°00'00" N. to 28°10'00" N., 89°15'00" W. to 89°30'00" W	VI	Do.

DREDGED MATERIAL SITES

(All dredged material sites will be retained under EPA Headquarters management until formally approved for continuing use or otherwise assigned for Regional management prior to such designation.)

LOCATION (LAT., LONG.)

Marblehead, MA—42°25'42" N., 70°34'00" W. (2 N. Mi. diameter).

Boston, MA—41°49'00" N., 70°25'00" W. (1 N. Mi. diameter).

Portland, ME—43°32'18" N., 70°06'06" W. (1 Mi. diameter).

Cape Arundel, ME—43°17'45" N., 70°27'12" W. (500 yds. diameter).

Absecon Inlet—39°21'07" N., 74°23'40" W.; 39°21'13" N., 74°23'53" W.

Cold Spring Inlet—38°55'41" N., 74°53'05" W.; 38°55'33" N., 74°53'23" W.

Manasquan Inlet—40°06'22" N., 74°01'46" W.; 40°06'38" N., 74°01'39" W.

East Rockaway—40°34'36" N., 73°49'00" W.; 40°35'06" N., 73°47'06" W.; 40°34'10" N., 73°48'36" W.; 40°34'12" N., 73°47'17" W.

Jones Inlet—40°34'32" N., 73°39'14" W.; 40°34'32" N., 73°37'06" W.; 40°33'48" N., 73°37'06" W.; 40°33'48" N., 73°39'14" W.

Fire Island—40°36'49" N., 73°23'50" W.; 40°37'13" N., 73°21'30" W.; 40°36'41" N., 73°21'20" W.; 40°36'10" N., 73°23'40" W.

Mud Dump—40°23'48" N., 73°51'28" W.; 40°21'48" N., 73°50'00" W.; 40°21'48" N., 73°51'28" W.; 40°23'48" N.; 73°50'00" W.

Shark River—40°12'48" N., 73°59'45" W.; 40°12'44" N., 73°59'06" W.; 40°11'36" N., 73°59'28" W.; 40°11'42" N., 74°00'12" W.

Rockaway Inlet—40°32'30" N., 73°55'00" W.; 40°32'30" N., 73°54'00" W.; 40°32'00" N., 73°54'00" W.; 40°32'00" N., 73°55'00" W.

San Juan Harbor—18°30'10" N., 66°08'29" W.; 18°30'10" N., 66°09'31" W.

Mayaguez Harbor—18°14'30" N., 67°13'29" W.; 18°15'30" N., 67°14'31" W.

Arecibo Harbor—18°30'00" N., 66°42'45" W.; 18°31'00" N., 66°43'47" W.

Ponce Harbor—17°55'30" N., 66°38'29" W.; 17°54'30" N., 66°39'31" W.

Dam Neck—36°50'06" N., 75°53'17" W.; °36-46'28" N., 75°53'17" W.; 36°46'28" N., 75°54'19" W.; 36°50'05" N., 75°54'19" W.

Wilmington Harbor, NC—Hopper dredge disposal in area east of a line beginning 33°50'00" and 78°02'30" to 33°48'45" and 78°04'00" to 33°45'00" and 78°05'00".

Morehead City Harbor—Maintenance dredging hoper dredge disposal area 3 miles x 3 miles; aproximate latitude and longitude, bounded north 34°40'00", south 34°38'30", east 76°41'00", west 76°43'00".

Georgetown Harbor—33°11'18" N., 79°07'20" W.; 33°11'18" N., 79°05'23" W.; 33°10'38" N., 79°07'21" W.; 33°10'38" N., 79°05'24" W.

Charleston Harbor—32°18'06" N., 79°41'57" W.; 32°40'42" N., 79°47'30" W.; 32°39'04" N., 79°48'21" W.; 32°36'28" N., 79°43'48" W.

Port Royal Harbor—32°10'11" N., 80°36'00" W.; 32°10'06" N., 80°36'35" W.; 32°08'41" N., 80°35'49" W.; 32°08'38" N., 80°36'23" W.

Port Royal Harbor—32°05'46" N., 80°35'30" W.; 32°05'42" N., 80°36'27" W.; 32°04'27" N., 80°35'18" W.; 32°04'22" N., 80°36'16" W.

Brunswick Harbor—Atlantic outlet, Ga., St. Simons Sound, Brunswick Harbor Bar Channel, maintenance dredging disposal area 1 nautical mile wide by 2 nautical miles long adjacent to the channel located on the south side of the entrance and being 6.6 nautical miles from shore at a point of beginning at 31°02'35" N. and 81°17'40" W., thence due east to 81°02'35" N. and 81°16'30" W., thence due south to 31°00'30" N. and 81°16'30" W., thence due west to 31°00'30" N. and 81°16'30" W., thence due north to the point of beginning.

Savannah River—Atlantic outlet, Ga., Savannah River Bar Channel, maintenance dredging disposal area 2 nautical miles wide by 2 nautical miles long adjacent to the channel, located on the southeast side and being 6 nautical miles from shore at point of beginning at 31°57'55" N. and 80°46'58" W., thence due east to 31°57'55" N. and 80°44'20" W., thence due south to 31°55'53" N. and 80°46'48" W., thence northward to the point of beginning.

Canaveral Harbor—28°19'53" N., 80°31'08" W.; 28°18'50" N., 80°29'40" W.; 28°17'35" N., 80°30'52" W.; 28°18'38" N., 80°32'20" W.

Fort Pierce Harbor—27°28'30" N., 80°12'33" W.; 27°28'30" N., 80°11'27" W.; 27°27'30" N., 80°11'27" W.; 27°27'30" N., 80°12'33" W.

Jacksonville Harbor—30°21'30" N., 81°18'34" W.; 30°21'30" N., 81°17'26" W.; 30°20'30" N., 81°17'26" W.; 30°20'30" N., 81°18'34" W.

Miami Beach—25°45'30" N., 80°03'54" W.; 25°45'30" N., 80°02'50" W.; 25°44'30" N., 80°02'50" W.; 25°44'30" N., 80°03'54" W.

Palm Beach Harbor—26°46'10" N., 80°02'00" W.; 26°45'54" N., 80°02'06" W.; 26°45'54" N., 80°02'13" W.; 26°46'10" N., 80°02'07" W.

Port Everglades Harbor—26°07'00" N., 80°04'30" W.; 26°07'00" N., 80°03'30" W.; 26°06'00" N., 80°03'30" W.; 26°06'00" N., 80°04'30" W.

St. Augustine Harbor—29°51'33" N., 81°15'24" W.; 29°51'33" N., 81°15'00" W.; 29°50'33" N., 81°15'00" W.; 29°50'33" N., 81°15'24" W.

St. Augustine Harbor—29°55'04" N., 81°17'04" W.; 29°55'13" N., 81°16'11" W.; 29°54'30" N., 81°15'56" W.; 29°54'19" N., 81°16'51" W.

St. Lucie Inlet—27°09'58" N., 80°09'30" W.; 27°09'59" N., 80°08'42" W.; 27°09'52" N., 80°08'42" W.; 27°09'52" N., 80°09'30" W.

Charlotte Harbor—26°37'36" N., 82°19'55" W.; 26°37'36" N., 82°18'47" W.; 26°36'36" N., 82°18'47" W.; 26°36'36" N., 82°19'55" W.

Tampa Harbor—27°38'08" N., 82°55'06" W.; 27°38'08" N., 82°54'00" W.; 27°37'08" N., 82°54'00" W.; 27°37'08" N., 82°55'06" W.

Tampa Harbor—27°37'28" N., 83°00'09" W.; 27°37'34" N., 82°59'19" W.; 27°36'43" N., 82°59'13" W.; 27°36'37" N., 83°00'03" W.

Fernandina Harbor—30°42'00" N., 81°19'05" W.; 30°42'00" N., 81°17'55" W.; 30°41'00" N., 81°17'55" W.; 30°41'00" N., 81°19'05" W.

Ponce de Leon Inlet—29°06'05" N., 80°55'50" W.; 29°06'10" N., 80°55'40" W.; 29°05'34" N., 80°55'10" W.; 29°05'28" N., 80°55'20" W.

Ponce de Leon Inlet—29°04'46" N., 80°53'40" W.; 29°04'36" N., 80°53'40" W.; 29°04'36" N., 80°54'26" W.; 29°04'46" N., 80°54'26" W.

Palm Beach Harbor—26°46'00" N., 79°58'55" W.; 26°46'00" N., 79°57'47" W.; 26°45'00" N., 79°57'47" W.; 26°45'00" N., 79°58'55" W.

Largo Sound—25°06'06" N., 80°24'42" W.; 25°05'58" N., 80°24'05" W.; 25°05'50" N., 80°24'10" W.; 25°05'58" N., 80°24'47" W.

Key West—24°27'24" N., 81°45'38" W.; 24°27'24" N., 81°44'32" W.; 24°26'20" N., 81°44'32" W.; 24°26'20" N., 81°45'38" W.

Anclote, FL—28°09'00" N., 83°51'48" W.; 28°09'00" N., 83°50'54" W.; 28°08'30" N., 83°50'54" W.; 28°08'30" N., 83°51'48" W.

Pithlachascotee River, FL—28°17'03" N., 82°46'21" W.; 28°17'02" N., 82°45'12" W.; 28°16'25" N., 82°45'00" W.; 28°16'42" N., 82°45'00" W.; 28°16'42" N., 82°46'21" W.

Withlacoochee River, FL—29°59'54" N., 82°47'14" W.; 29°00'28" N., 82°46'06" W.; 29°00'14" N., 82°45'58" W.; 28°59'40" N., 82°47'06" W.

Withlacoochee River, FL—28°59'08" N., 82°48'48" W.; 28°59'32" N., 82°47'40" W.; 28°59'18" N., 82°47'32" W.; 28°58'54" N., 82°48'40" W.

Cedar Keys, FL—29°08'43" N., 83°07'53" W.; 29°08'43" N., 83°07'03" W.; 29°08'33" N., 83°07'03" W.; 29°08'33" N., 83°07'53" W.

Cedar Keys, FL—29°04'08" N., 83°04'06" W.; 29°04'01" N., 83°03'54" W.; 29°03'28" N., 83°04'12" W.; 29°03'35" N., 83°04'24" W.

Horseshoe Cove, FL—29°25'23" N., 83°17'53" W.; 29°25'18" N., 83°17'43" W.; 29°25'09" N., 83°17'49" W.; 29°25'14" N., 83°17'59" W.

Horseshoe Cove, FL—29°25'58" N., 83°17'32" W.; 29°25'53" N., 83°17'22" W.; 29°25'44" N., 83°17'28" W.; 29°25'49" N., 83°17'38" W.

Mobile, AL—30°10.0' N., 88°07.7' W.; 30°10.4' N., 88°05.2' W.; 30°09.4' N., 88°04.7' W.; 30°08.5' N., 88°05.2' W.; 30°08.5' N., 88°08.2' W.

Pascagoula, MS—30°11.9' N., 88°33.1' W.; 30°11.9' N., 88°32.8' W.; 30°11.6' N., 88°32.4' W.; 30°11.6' N., 88°32.1' W.; 30°10.5' N., 88°33.2' W.; 30°10.6' N., 88°34.0' W.

Gulfport, MS—30°12.0' N., 89°00.5' W.; 30°12.0' N., 88°59.5' W.; 30°11.0' N., 89°00.0' W.; 30°07.0' N., 88°56.5' W.; 30°06.6' N., 88°57.0' W.; 30°10.5' N., 89°00.6' W.

Gulfport, MS—30°11.3' N., 88°58.4' W.; 30°11.2' N., 88°57.5' W.; 30°07.6' N., 88°54.4' W.; 30°07.4' N., 88°54.8' W.

Pensacola, FL—30°16.8' N., 87°19.0' W.; 30°16.7' N., 87°18.3' W.; 30°16.3' N., 87°18.2' W.; 30°16.0' N., 87°19.4' W.; 30°16.5' N., 87°19.4' W.

Panama City, FL—30°07.1' N., 85°45.9' W.; 30°07.2' N., 85°45.5' W.; 30°06.9' N., 85°45.1' W.; 30°06.7' N., 85°45.6' W.

Port St. Joe, FL—29°50.9' N., 85°29.0' W.; 29°51.3' N., 85°29.5' W.; 29°49.2' N., 85°28.2' W.; 29°49.0' N., 85°28.8' W.

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Port St. Joe, FL—29°53.9' N., 85°31.8' W.; 29°54.1' N., 85°31.3' W.; 29°52.2' N., 85°30.1' W.; 29°52.2' N., 85°30.8' W.

SABINE-NECHES WATERWAY, TEXAS

Disposal Area No. 1—Beginning at lat. 29°28'03", long. 93°41'14"; thence to lat. 29°26'11", long. 93°41'14"; thence to lat. 29°26'11", long. 93°44'14"; thence to point of beginning.

Disposal Area No. 2—Beginning at lat. 29°30'41", long. 93°43'49"; thence to lat. 29°28'42", long. 93°41'33"; thence to lat. 29°28'42", long. 93°44'49"; thence to lat. 29°26'11", long. 3°44'11"; thence to point of beginning.

Disposal Area No. 3—Beginning at lat. 29°34'24", long. 93°48'13"; thence to lat. 29°32'47", long. 93°46'16"; thence to lat. 29°32'06", long. 93°46'29"; thence to lat. 29°31'42", long. 93°48'16"; thence to lat. 29°32'59", long. 93°49'48"; thence to point of beginning.

Disposal Area No. 4—Beginning at lat. 29°38'09", long. 93°49'23"; thence to lat. 29°35'53", long. 93°48'18"; thence to lat. 29°35'06", long. 93°50'24"; thence to lat. 29°36'37", long. 93°51'09"; thence to lat. 29°37'00", long. 93°50'06"; thence to lat. 29°37'46", long. 93°50'26"; thence to point of beginning.

GALVESTON HARBOR AND CHANNEL, TEXAS

Disposal Area No. 1—Beginning at lat. 29°18'00", long. 94°39'30"; thence to lat. 29°15'54", long. 94°37'08"; thence to lat. 29°14'24", long. 94°38'42"; thence to lat. 29°16'54", long. 94°41'30"; thence to point of beginning.

FREEPORT HARBOR, TEXAS

Disposal Area No. 1—Beginning at lat. 28°54'42", long. 95°17'38"; thence to lat. 28°54'-3"; long. 95°16'54"; thence to lat. 28°53'48", long. 95°17'27"; thence to lat. 28°54'21", long. 95°18'03"; thence to point of beginning.

MATAGORDA SHIP CHANNEL

Disposal Area No. 1—Beginning at lat. 28°24'31", long. 96°18'[illegible]"; thence to lat. 28°23'27", long. 96°17'38"; thence to lat. 28°23'15", long 96°17'54"; thence to lat. 28°24'[illegible]", long. 96°19'03"; thence to point of beginning.

CORPUS CHRISTI SHIP CHANNEL

Disposal Area No. 1—Beginning at lat. 27°49'34", long. 97°01'51"; thence to lat. 27°48'28", long. 96°59'49"; thence to lat. 27°48'18", long. 96°59'56"; thence to lat. 27°49'23", long. 97°01'58"; thence to point of beginning.

PORT MANSFIELD CHANNEL

Disposal Area No. 1—Beginning at lat. 26°34'09", long. 97°15'52"; thence to lat. 26°34'09", long. 97°15'18"; thence to lat. 26°33'57", long. 97°15'18"; thence to lat. 26°33'57", long. 97°15'52"; thence to point of beginning.

Disposal Area No. 1-A—Beginning at lat. 26°34'17", long. 97°16'12"; thence to lat. 26°34'18", long. 97°15'55"; thence to lat. 26°33'59", long. 97°15'52"; thence to lat. 26°33'58", long. 97°16'11"; thence to point of beginning.

BRAZOS ISLAND HARBOR

Disposal Area No. 1—Beginning at lat. 26°04'38", long. 97°07'52"; thence to lat. 26°04'38", long. 97°06'42"; thence to lat. 26°04'05", long. 97°06'42"; thence to lat. 26°04'05", long. 97°07'52"; thence to point of beginning.

Mississippi River, Gulf Outlet, La.—Breton Sound and Bar Channel. Maintenance dredging disposal area 0.5 mile wide by 12.5 miles long, parallel to the channel and located on the south side. Beginning at 29°32'23" N. and 89°12'20" W., *following* channel centerline (azimuth 308°47') in Breton Sound to 29°29'15" N. and 89°07'06" W., following centerline (azimuth 300°36') of the gulf entrance channel to 29°25'06" N. and 88°59'54" W., thence to 29°24'45" N. and 89°00'09" W., thence to 29°28'53" N., and 89°08'08" W., thence to 29°31'41" N. and 89°12'09" W., thence to the point of beginning.

Mississippi River, Baton Rouge to the Gulf of Mexico, La.—South Pass. Maintenance dredging disposal area 0.5 mile square, parallel to the channel and located on the west side. Beginning at 28°58'33" N. and 89°07'00" W., following channel centerline (azimuth 295°41') of the gulf entrance channel to 28°58'24" N. and 89°06'30" W., thence to 28°57'54" N. and 89°06'42" W., thence to 23°58'06" N. and 89°07'18" W., thence to the point of beginning.

Mississippi River, Baton Rouge to the Gulf of Mexico, La.—Southwest Pass. Maintenance dredging disposal area 2 miles square, parallel to the channel and located on the west side. Beginning at 28°54'24" N. and 89°26'03" W., following channel centerline (azimuth 0°09') of the gulf entrance channel to 28°52'18" N. and 89°26'03" W., thence to 28°52'18" N. and 89°27'48" W., thence to 28°54'24" N. and 89°27'48" W., thence to the point of beginning.

Mississippi River Outlets, Venice, La.—Tiger Pass. Maintenance dredging disposal area 0.5 mile wide by 1.5 miles long, parallel to the channel and located on the north side. Beginning at 29°08'18" N. and 89°25'45" W., following channel centerline (azimuth 63°54') of the gulf entrance channel to 29°07'36" N. and 89°26'51" W., thence to 29°07'48" N. and 89°27'00" W., thence to 29°08'36" N. and 89°25'57" W., thence to the point of beginning.

Waterway from Empire, La. to the Gulf of Mexico—Bar channel. Maintenance dredging disposal area 0.5 mile wide by 1 mile long, parallel to the channel and located *on the west side. Beginning at 29°15'06"* N. and 89°36'30" W., following channel centerline (azimuth 11°08') of the gulf entrance channel to 29°14'30" N. and 89°36'36" W., thence to 29°14'36" N. and 89°36'48" W., thence to 29°15'12" N. and 89°36'42" W., thence to the point of beginning.

Barataria Bay Waterway, La.—Bar channel. *Maintenance* dredging disposal area 0.5 mile wide by 2 miles long, parallel to the channel and located on the east side. Beginning at 29°16'18" N. and 89°56'12" W., following channel centerline (azimuth 312°07') of the gulf entrance channel to 29°14'42" N. and 89°54'36" W., thence to 29°14'30" N. and 89°54'24" W., thence to 29°16'06" N. and 89°56'24" W., thence to the point *of beginning.*

Bayou Lafourche and Lafourche—Jump Waterway, La.—Bell Pass. Maintenance *dredging disposal area 2,000 feet* wide by 1.5 miles long, parallel to the channel and located on the west side. Beginning at *29°05'00" N. and 90°13'45" W., following* Bell Pass centerline (azimuth 12°55') in the gulf entrance channel to 29°03'51" N. and *90°14'06" W., thence to* 29°03'57" N. and 90°14'21" W., thence to 29°05'06" N. and 90°14'03" W., thence to the point of *beginning.*

Houma Navigation Canal, La.—Cat Island Pass. Maintenance dredging disposal area 0.5 mile wide by *5 miles long, parallel to* the Cat Island channel and located on the west side. Beginning at 29°04'45" N. and 90°34'48" W., following Cat Island centerline *(azimuth 358°41')* of the gulf entrance channel to 29°03'42" N. and 90°34'34" W., following Cat Island center-*line (azimuth 3[illegible]4°00') of the gulf entrance* channel to 29°00'24" N. and 90°34'12" W., thence to 29°00'21" N. and 90°34'36" W., thence to 29°03'42" N. and 90°34'58" W., thence to 29°04'48" N. and 90°35'18" W., thence to the point of beginning.

Atchafalaya River—Morgan City to the Gulf of Mexico, La. and Atchafalaya River and Bayous Chene, Boeuf and Black, La.—Bar channel. Maintenance dredging disposal area 0.5 mile wide by 12 miles long, parallel to the bar channel and located on the east side. Beginning at 29°20'50" N. and 91°24'03" W., following channel centerline (azimuth 37°57') of the gulf entrance channel to 29°11'35" N. and 91°32'10" W., thence to 29°11'21" N. and 91°31'37" W., thence to 29°20'36" N. and 91°23'27" W., thence to the point of beginning.

Freshwater Bayou, La.—Bar channel. Maintenance dredging disposal area 2,000 feet wide by 3.5 miles long, parallel to the channel and located on the west side. Beginning at 29°32'00" N. and 92°18'48" W., following channel centerline (azimuth 09°25') of the gulf entrance to 29°28'24" N. and 92°19'30" W., thence to 29°28'25" N. and 92°19'42" W., thence to 29°32'01" N. and 92°19'00" W., thence to the point of beginning.

Mermentau River, La. Maintenance dredging disposal areas 0.5 mile wide and 1.5 miles long, parallel to the entrance channels in the Lower Mermentau River and in the Lower Mud Lake, both located on the west side:

Disposal Area "A", Mermentau River, La. Beginning at 29°44'48" N. and 93°07'12" W., following channel centerline (azimuth 236°59') of the gulf entrance to 29°43'39" N. and 93°07'36" W., thence to 29°43'42" N. and 93°07'48" W., thence to 29°44'51" N. and 93°07'24" W., thence to the point of beginning.

Disposal Area "B", Mermentau River, La. Beginning at 29°43'24" N. and 93°01'54" W., *following channel centerline (azimuth* 359°50') of the gulf entrance to 29°42'33" N. and 93°02'12" W., thence to 29°42'36" N. and 93°02'24" W., thence to 29°43'27" N. and 93°02'05" W., thence to the point of beginning.

Calcasieu River and Pass, La.—Bar channel. Maintenance dredging disposal areas A through G parallel to the channel and located on the east and west side:

Disposal Area "A", Calcasieu River and Pass, La. Maintenance dredging disposal area one mile square parallel to the bar channel on the west bank. Beginning at 29°45'09" N. and 93°20'42" W., following channel centerline (azimuth 351°50') of the first tangent gulfward in the gulf entrance channel to 29°44'39" N. and 93°20'36" W., thence to 29°44'36" N. and 93°21'33" W., thence to 29°45'12" N. and 93°21'42" W., thence to the point of beginning.

Disposal Area "B", Calcasieu River and Pass, La. Maintenance dredging disposal area 1 mile square parallel to the bar channel and located on the east bank. Beginning at 29°45'27" N. and 93°20'33" W., following channel centerline (azimuth 351°50') of *the first tangent gulfward in the gulf* entrance channel to 29°44'42" N. and 93°20'24" W., thence to 29°44'45" N. and 93°19'30" W., *thence* to 29°45'39" N. and 93°19'36" W., thence to the point of beginning.

Disposal Area "C", Calcasieu River and Pass, La. Maintenance dredging disposal area 1 mile wide by 5.5 miles long, parallel to the

bar channel and located on the west side. Beginning at 29°44'30" N. and 93°20'36" W., following channel centerline (azimuth 351°50') of the first tangent gulfward in the gulf entrance channel to 29°39'48" N. and 93°19'48" W., thence to 29°39'42" N. and 93°20'48" W., thence to 29°44'24" N. and 93°21'30" W., thence to the point of beginning.

Disposal Area "D", Calcasieu River and Pass, La. Maintenance dredging disposal area 1 mile wide by 5.5 miles long, parallel to the bar channel and located on the west side. Beginning at 29°37'43" N. and 93°19'24" W., following channel centerline (azimuth 351°50') of the first tangent gulfward in the gulf entrance channel to 29°37'24" N. and 93°19'21" W., following channel centerline (azimuth 321°37') of the second tangent gulfward in the gulf entrance channel to 29°34'12" N. and 93°16'18" W., thence to 29°33'06" N. and 93°16'36" W., thence to 29°37'24" N. and 93°20'24" W., thence to 29°37'48" N. and 93°20'24" W., thence to the point of beginning.

Disposal Area "E", Calcasieu River and Pass, La. Maintenance dredging disposal area 0.75 mile wide by 6.75 miles long, parallel to the bar channel and located on the west side. Beginning at 29°33'54" N. and 93°16'24" W., following channel centerline (azimuth 321°37') of the second tangent gulfward in the gulf entrance channel to 29°31'00" N. and 93°13'48" W., following channel centerline (azimuth 358°56') of the third tangent gulfward in the gulf entrance channel to 29°29'00" N. and 93°13'42" W. thence to 29°28'54" N. and 93°14'24" W., thence to 29°30'54" N. and 93°14'24" W., thence to 29°33'12" N. and 93°16'36" W., thence to the point of beginning.

Disposal Area "F", Calcasieu River and Pass, La. Maintenance dredging disposal area 0.75 mile wide by 2.5 miles long, parallel to the bar channel and located on the east side. Beginning at 29°44'42" N. and 93°20'12" W., following channel centerline (azimuth 351°50') of the first tangent gulfward in the gulf entrance channel to 29°42'36" N. and 93°19'48" W., thence to 29°42'42" N. and 93°19'06" W., thence to 29°44'48" N. and 93°19'24" W., thence to the point of beginning.

Disposal Area "G", Calcasieu River and Pass, La. Maintenance dredging disposal area 1 mile wide by 0.5 mile long, parallel to the bar channel and located on the west side. Beginning at 29°44'54" N., and 93°20'36" W., following channel centerline (azimuth 351°50') of the first tangent gulfward in the gulf entrance channel to 29°44'42" N., and 93°20'36" W., thence to 29°44'42" N., and 93°20'48" W., following channel centerline again to 29°44'30" N., and 93°20'42" W., thence to 29°44'24" N. and 93°21'30" W., thence to 29°44'48" N. and 93°21'30" W., thence to the point of beginning.

Crescent City Harbor—41°43'15" N., 124°12'10" W. (1,000 yd. diameter)
Crescent City 100 fathom—41°43'50" N., 124°28'00" W. (1,000 yd. diameter)
Humboldt Bay Harbor—40°45'44" N., 124°15'42" W. (500 yd. diameter)
Noyo River—39°25'45" N., 123°49'42" W. (500 yd. diameter)
Farallon Islands—37°31'45" N., 122°59'00" W. (1,000 yd. radius)
San Francisco Channel Bar—37°45'06" N., 122°35'45" W. (5,000 yds. x 1,000 yds.)
Moss Landing 100 fathom—36°37'53" N., 121°49'04" W. (500 yd. radius)
Port Hueneme—34°05'00" N., 119°14'00" W. (1,000 yd. radius)
Los Angeles—33°37'06" N., 118°17'24" W. (1,000 yd. radius)
Newport Beach—33°31'42" N., 117°54'48" W. (1,000 yd. radius)
San Diego—Point Loma—32°35'00" N., 117°17'30" W. (1,000 yd. radius)
San Diego 100 fathom—32°36'50" N., 117°20'40" W. (1,000 yd. radius)
Honolulu Harbor—21°14'30" N., 157°54'30" W. (1,000 yd. radius)
Kauai—Nawiliwili—21°55'30" N., 159°17'00" W. (1,000 yd. radius)
Kauai—Hanapepe—21°50'18" N., 159°35'30" W. (1,000 yd. radius)
Guam—Apra Harbor—13°29'30" N., 144°34'30" E. (1,000 yd. radius)
American Samoa—Pago Pago Harbor—14°23'00" S., 170°39'30" W. (1,000 yd. radius)
Mouth of Columbia River—46°14'37" N., 124°10'34" W.; 46°13'53" N., 124°10'01" W.; 46°13'43" N., 124°10'26" W.; 46°14'28" N., 124°10'59" W.
Mouth of Columbia River—46°13'03" N., 124°06'17" W.; 46°12'50" N., 124°05'55" W.; 46°12'13" N., 124°06'43" W.; 46°12'26" N., 124°07'05" W.
Mouth of Columbia River—46°15'43" N., 124°05'21" W.; 46°15'36" N., 124°05'11" W.; 46°15'11" N., 124°05'53" W.; 46°15'18" N., 124°06'03" W.
Mouth of Columbia River—46°12'12" N., 124°09'00" W.; 46°12'00" N., 124°08'42" W.; 46°11'48" N., 124°09'00" W.; 46°12'00" N., 124°09'18" W.
Mouth of Columbia River—46°12'05" N., 124°05'46" W.; 46°11'52" N., 124°05'25" W.; 46°11'15" N., 124°06'14" W.; 46°11'28" N., 124°06'35" W.
Chetco River Entrance—42°01'56" N., 124°16'33" W.; 42°01'56" N., 124°16'09" W.; 42°01'38" N., 124°16'09" W.; 42°01'38" N., 124°16'33" W.
Rogue River Entrance—42°24'16" N., 124°26'48" W.; 42°24'04" N., 124°25'35" W.; 42°23'40" N., 124°27'13" W.; 42°23'52" N., 124°27'26" W.
Coquille River Entrance—43°07'54" N., 124°27'04" W.; 43°07'30" N., 124°26'27" W.; 43°07'20" N., 124°26'40" W.; 43°07'44" N., 124°27'17" W.
Coos Bay Entrance—43°21'59" N., 124°22'45" W.; 43°21'48" N., 124°21'59" W.; 43°21'35" N., 124°22'05" W.; 43°21'46" N., 124°22'51" W.
Coos Bay Entrance—43°22'44" N., 124°22'18" W.; 43°22'29" N., 124°21'34" W.; 43°22'16" N., 124°21'42" W.; 43°22'31" N., 124°22'26" W.
Umpqua River Entrance—43°40'07" N., 124°14'18" W.; 43°40'07" N., 124°13'42" W.; 43°39'53" N., 124°13'42" W.; 43°39'53" N., 124°14'18" W.
Siuslaw River Entrance—44°01'32" N., 124°09'37" W.; 44°01'22" N., 124°09'02" W.; 44°01'14" N., 124°09'07" W.; 44°01'24" N., 124°09'42" W.
Tillamook Bay Entrance—45°34'09" N., 123°59'37" W.; 45°34'09" N., 123°58'45" W.; 45°33'55" N., 123°58'45" W.; 45°33'55" N., 123°59'37" W.
Depoe Bay—44°48'33" N., 124°03'53" W.; 44°48'32" N., 124°03'43" W.; 44°48'15" N., 124°03'45" W.; 44°48'16" N., 124°03'55" W.
Depoe Bay—44°48'09" N., 124°05'05" W.; 44°48'09" N., 124°04'55" W.; 44°47'53" N., 124°04'55" W.; 44°47'53" N., 124°05'05" W.
Yaquina Bay and Harbor Entrance—44°36'31" N., 124°06'04" W.; 44°36'31" N., 124°05'16" W.; 44°36'17" N., 124°05'16" W.; 44°36'17" N., 124°06'04" W.
Port Orford—42°44'08" N., 124°29'38" W.; 42°44'08" N., 124°29'28" W.; 42°43'52" N., 124°29'28" W.; 42°43'52" N., 124°29'38" W.
Willapa Bay—46°44'00" N., 124°10'00" W.; 46°39'00" N., 124°09'00" W.
Nome—64°30'40" N., 165°25'52" W.; 64°29'18" N., 165°26'04" W.; 64°29'13" N., 165°25'22" W.; 64°29'54" N., 165°24'45" W.
Anchorage Harbor—61°14'07" N., 149°53'56" W.; 61°14'16" N., 149°54'15" W.; 61°14'15" N., 149°53'36" W.; 61°14'35" N., 149°53'17" W.

(b) The following sites are designated "Approved Ocean Dumping Sites" for continuing use, subject to the listed restrictions:

(1) Gulf Ocean Incineration Site—Region VI. Location—Latitude and Longitude—27°06'12" N., 93°24'15" W.; 26°32'24" N., 93°15'30" W.; 26°19'00" N., 93°56'00" W.; 26°52'40" N., 94°04'40" W.
Size—(square miles) 1892.
Depth—(feet) 4500.
Primary Use: At sea incineration primarily for organochlorine wastes. Incineration of other wastes will require research studies or equivalent technical documentation to determine acceptability for ocean incineration.
Period of use: Until September 15, 1981.
Restriction: *Only one ship will be permitted to burn wastes at a time, except under extreme emergencies.*

§ 228.13 Guidelines for ocean disposal site baseline or trend assessment surveys under Section 102 of the Act.

The purpose of a baseline or trend assessment survey is to determine the physical, chemical, geological, and biological structure of a proposed or existing disposal site at the time of the survey. A baseline or trend assessment survey is to be regarded as a comprehensive synoptic and representative picture of existing conditions; each such survey is to be planned as part of a continual monitoring program through which changes in conditions at a disposal site can be documented and assessed. Surveys will be planned in coordination with the ongoing programs of NOAA and other Federal, State, local, or private agencies with missions in the marine environment. The field survey data collection phase of a disposal site evaluation or designation study shall be planned and conducted to obtain a body of information both representative of the site at the time of study and obtained by techniques reproducible in precision and accuracy in future studies. A full plan of study which will provide a record of sampling, analytical, and data reduction procedures must be developed, documented and approved by the EPA management authority. Plans for all surveys which will produce information to be used in the preparation of environmental impact statements will be approved by the Administrator or his designee. This plan of study also shall be incorporated as an appendix into a technical report on the study, together with notations describing deviations from the plan required in actual operations. Relative emphasis on individual aspects of the environment at each site will depend on the type of wastes disposed of at the site and the manner in which such wastes are likely to affect the local environment, but no major feature of the disposal site may be neglected. The observations made and the data obtained are to be based on the information necessary to evaluate the site for ocean dumping. The parameters measured will be those indicative, either directly or in directly, of the immediate and long-term impact of pollutants on the environment at the disposal site and adjacent land or water areas. An

initial disposal site evaluation or designation study should provide an immediate baseline appraisal of a particular site, but it should also be regarded as the first of a series of studies to be continued as long as the site is used for waste disposal.

(a) *Timing*. Baseline or trend assessment surveys will be conducted with due regard for climatic and seasonal impact on stratification and other conditions in the upper layers of the water column. Where a choice of season is feasible, trend assessment surveys should be made during those months when pollutant accumulation within disposal sites is likely to be most severe, or when pollutant impact within disposal sites is likely to be most noticeable.

(1) Where disposal sites are near large riverine inflows to the ocean, surveys will be done with due regard for the seasonal variation in river flow. In some cases several surveys at various river flows may be necessary before a site can be approved.

(2) When initial surveys show that seasonal variation is not significant and surveys at greater than seasonal intervals are adequate for characterizing a site, resurveys shall be carried out in climatic conditions as similar to those of the original surveys as possible, particularly in depths less than 200 meters.

(b) *Duration*. The actual duration of a field survey will depend upon the size and depth of the site, weather conditions during the survey, and the types of data to be collected. For example, for a survey of an area of 100 square miles on the continental shelf, including an average dump site and the region contiguous to it, an on-site operation would be scheduled for completion within one week of weather suitable for on-site operations. More on-site operating time may be scheduled for larger or highly complex sites.

(c) *Numbers and Locations of Sampling Stations*. The numbers and locations of sampling stations will depend in part on the local bathymetry with minimum numbers of stations per site fixed as specified in the following sections. Where the bottom is smooth or evenly sloping, stations for water column measurements and benthic sampling and collections, other than trawls, shall be spaced throughout the survey area in a manner planned to provide maximum coverage of both the disposal site and contiguous control areas, considering known water movement characteristics. Where there are major irregularities in the bottom topography, such as canyons or gullies, or in the nature of the bottom, sampling stations for sediments and benthic communities shall be spaced to provide representative sampling of the major different features.

Sampling shall be done within the dump site itself and in the contiguous area. Sufficient control stations outside a disposal site shall be occupied to characterize the control area environment at least as well as the disposal site itself. Where there are known persistent currents, sampling in contiguous areas shall include at least two stations downcurrent of the dump site, and at least two stations upcurrent of the site.

(d) *Measurements in the Water Column at and near the Dump Site.*

(1) *Water Quality Parameters Measured*. These shall include the major indicators of water quality, particularly those likely to be affected by the waste proposed to be dumped. Specifically included at all stations are measurements of temperature, dissolved oxygen, salinity, suspended solids, turbidity, total organic carbon, pH, inorganic nutrients, and chlorophyll *a*.

(i) At one station near the center of the disposal site, samples of the water column shall be taken for the analysis of the following parameters: mercury, cadmium, copper, chromium, zinc, lead, arsenic, selenium, vanadium, beryllium, nickel, pesticides, petroleum hydrocarbons, and persistent organohalogens. These samples shall be preserved for subsequent analysis by or under the direct supervision of EPA laboratories in accordance with the approved plan of study.

(ii) These parameters are the basic requirements for all sites. For the evaluation of any specific disposal site additional measurements may be required, depending on the present or intended use of the site. Additional parameters may be selected based on the materials likely to be in wastes dumped at the site, and on parameters likely to be affected by constituents of such wastes. Analysis for other constituents characteristic of wastes discharged to a particular disposal site, or of the impact of such wastes on water quality, will be included in accordance with the approved plan of study.

(2) *Water Quality Sampling Requirements*. The number of samples collected from the water column should be sufficient to identify representative changes throughout the water column such as to avoid short-term impact due to disposal activities. The following key locations should be considered in selecting water column depths for sampling:

(i) Surface, below interference from surface waves;

(ii) Middle of the surface layer;

(iii) Bottom of the surface layer;

(iv) Middle of the thermocline or halocline, or both if present;

(v) Near the top of the stable layer beneath a thermocline or halocline;

(vi) Near the middle of a stable layer;

(vii) As near the bottom as feasible;

(viii) Near the center of any zone showing pronounced biological activity or lack thereof.

In very shallow waters where only a few of these would be pertinent, as a minimum, surface, mid-depth and bottom samples shall be taken, with samples at additional depths being added as indicated by local conditions. At disposal sites far enough away from the influence of major river inflows, ocean or coastal currents, or other features which might cause local perturbations in water chemistry, a minimum of 5 water chemistry stations should be occupied within the boundaries of a site. Additional stations should be added when the area to be covered in the survey is more than 20 square miles or when local perturbations in water chemistry may be expected because of the presence of one of the features mentioned above. In zones where such impacts are likely, stations shall be distributed so that at least 3 stations are occupied in the transition from one stable regime to another. Each water column chemistry station shall be replicated a minimum of 2 times during a survey except in waters over 200 meters deep.

(3) *Water Column Biota*. Sampling stations for the biota in the water column shall be as near as feasible to stations used for water quality; in addition at least two night-time stations in the disposal site and contiguous area are required. At each station vertical or oblique tows with appropriately-meshed nets shall be used to assess the microzooplankton, the nekton, and the macrozooplankton. Towing times and distances shall be sufficient to obtain representative samples of organisms near water quality stations. Organisms shall be sorted and identified to taxonomic levels necessary to identify dominant organisms, sensitive or indicator organisms, and organism diversity. Tissue samples of representative species shall be analyzed for pesticides, persistent organohalogens, and heavy metals. Discrete water samples shall also be used to quantitatively assess the phytoplankton at each station.

These requirements are the minimum necessary in all cases. Where there are discontinuities present, such as thermoclines, haloclines, convergences, or upwelling, additional tows shall be made in each water mass as appropriate.

(e) *Measurements of the Benthic Region.*

(1) *Bottom Sampling*. Samples of the bottom shall be taken for both sediment composition and structure, and to determine the nature and numbers of benthic biota.

(i) At each station sampling may consist of core samples, grab samples, dredge samples, trawls, and bottom photography or television, where available and feasible, depending on the nature of the bottom and the type of disposal site. Each type of sampling shall be replicated sufficiently to obtain a representative set of samples. The minimum numbers of replicates of successful samples at each continental shelf station for each type of device mentioned above are as follows:

Cores	3.
Grabs	5.
Dredge	3.
Trawl	20-min. tow.

Lesser numbers of replicates may be allowed in water deeper than 200 meters, at those sites where pollution impacts on the bottom are unlikely in the judgment of the EPA management authority.

(ii) Selection of bottom stations will be based to a large extent on the bottom topography and hydrography as determined by the bathymetric survey. On the continental shelf, where the bottom has no significant discontinuities, a

bottom station density of at least three times the water column stations is recommended, depending on the type of site being evaluated. Where there are significant differences in bottom topography, additional stations shall be occupied near the discontinuity and on each side of it. Beyond the continental shelf, lesser densities may be used.

(2) *Bathymetric Survey.* Sufficient tracklines shall be run to develop complete bottom coverage of bathymetry with reasonable assurance of accurate coverage of bottom topography, with trackline direction and spacing as close as available control allows. The site itself is to be developed at the greatest density possible, with data to be collected to a suitable distance about the site as is required to identify major changes in bathymetry which might affect the site. Specifications for each bathymetric survey will vary, depending on control, bottom complexity, depths, equipment, and map scale required. In most cases, a bathymetric map at a scale of 1:25,000 to 1:10,000 will be required, with a minimum of 1–5 meter contour interval except in very flat areas. When the foregoing bathymetric detail is available from recent surveys of the disposal site, bathymetry during a baseline or trend assessment survey may be limited to sonar profiles of bathymetry on transects between sampling stations.

(3) *Nature of Bottom.* The size distribution of sediments, mineral character and chemical quality of the bottom will be determined to a depth appropriate for the type of bottom. The following parameters will be measured at all stations: particle size distribution, major mineral constituents, texture, settling rate, and organic carbon.

(i) At several stations near the center of the disposal site, samples of sediments shall be taken for the analysis of the following parameters: mercury, cadmium, copper, chromium, zinc, lead, arsenic, selenium, vanadium, beryllium, nickel, pesticides, persistent organohalogens, and petroleum hydrocarbons. These samples shall be preserved for subsequent analysis by or under the direct supervision of EPA laboratories in accordance with the approved plan of study.

(ii) These parameters are the basic requirements for all sites. For the evaluation of any specific disposal site additional measurements may be required, depending on the present or intended use of the site. Additional parameters may be selected based on the materials likely to be in wastes dumped at the site, and on parameters likely to be affected by constituents of such wastes. Such additional parameters will be selected by the EPA management authority.

(4) *Benthic Biota.* This shall consist of a quantitative and qualitative evaluation of benthic communities including macroinfauna and macroepifauna, meiobenthos, and microbenthos, and should include an appraisal, based on existing information, of the sensitivity of indigenous species to the waste proposed to be discharged. Organisms shall be sorted and identified to taxonomic levels necessary to identify dominant organisms, sensitive or indicator organisms, and organism diversity. Tissue samples of the following types of organisms shall be analyzed for persistent organohalogens, pesticides, and heavy metals:

(i) A predominant species of demersal fish;

(ii) The most abundant macroinfaunal species; and

(iii) A dominant epifaunal species, with particular preference for a species of economic importance.

(f) *Other Measurements.*

(1) *Hydrodynamic Features.* The direction and speed of water movement shall be characterized at levels appropriate for the site and type of waste to be dumped. Where depths and climatic conditions are great enough for a thermocline or halocline to exist, the relationship of water movement to such a feature shall be characterized.

(i) *Current Measurements.* When current meters are used as the primary source of hydrodynamic data, at least 4 current meter stations with at least 3 meters at depths appropriate for the observed or expected discontinuities in the water column should be operated for as long as possible during the survey. Where feasible, current meters should be deployed at the initiation of the survey and recovered after its completion. Stations should be at least a mile apart, and should be placed along the long axis of the dumping site. For dumping sites more than 10 miles along the long axis, one current meter station every 5 miles should be operated. Where there are discontinuities in surface layers, e.g., due to land runoff, stations should be operated in each water mass.

(ii) *Water Mass Movement.* Acceptable methods include: dye, drogues, surface drifters, side scan sonar, bottom drifters, and bottom photography or television. When such techniques are the primary source of hydrodynamic data, coverage should be such that all significant hydrodynamic features likely to affect waste movement are measured.

(2) *Sea State.* Observations of sea state and of standard meteorological parameters shall be made at 8-hour intervals.

(3) *Surface Phenomena.* Observations shall be made of oil slicks, floating materials, and other visible evidence of pollution; and, where possible, collections of floating materials shall be made.

(g) *Survey Procedures and Techniques.* Techniques and procedures used for sampling and analysis shall represent the state-of-the-art in oceanographic survey and analytical practice. Survey plans shall specify the methods to be used and will be subject to approval by EPA.

(h) *Quality Assurance.* The EPA management authority may require that certain samples be submitted on a routine basis to EPA laboratories for analysis as well as being analyzed by the surveyor, and that EPA personnel participate in some field surveys.

PART 229—GENERAL PERMITS

AUTHORITY: 33 U.S.C. 1412 and 1418.

§ 229.1 Burial at sea.

(a) All persons subject to Title I of the Act are hereby granted a general permit to transport human remains from the United States and all persons owning or operating a vessel or aircraft registered in the United States or flying the United States flag and all departments, agencies, or instrumentalities of the United States are hereby granted a general permit to transport human remains from any location for the purpose of burial at sea and to bury such remains at sea subject to the following conditions:

(1) Except as herein otherwise provided, human remains shall be prepared for burial at sea and shall be buried in accordance with accepted practices and requirements as may be deemed appropriate and desirable by the United States Navy, United States Coast Guard, or civil authority charged with the responsibility for making such arrangements;

(2) Burial at sea of human remains which are not cremated shall take place no closer than three nautical miles from land and in water no less than one hundred fathoms (six hundred feet) deep and in no less than three hundred fathoms (eighteen hundred feet) from (i) 27°30′00″ to 31°00′00″ North Latitude off St. Augustine and Cape Canaveral, Florida; (ii) 82°20′00″ to 84°00′00″ West Longitude off Dry Tortugas, Florida; and (iii) 87°15′00″ to 89°50′00″ West Longitude off the Mississippi River Delta, Louisiana, to Pensacola, Florida. All necessary measures shall be taken to ensure that the remains sink to the bottom rapidly and permanently; and

(3) Cremated remains shall be buried in or on ocean waters without regard to the depth limitations specified in paragraph (a)(2) of this Section provided that such burial shall take place no closer than three nautical miles from land.

(b) For purposes of this Section and §§ 229.2 and 229.3, "land" means that portion of the baseline from which the territorial sea is measured, as provided for in the Convention on the Territorial Sea and the Contiguous Zone, which is in closest proximity to the proposed disposal site.

(c) Flowers and wreaths consisting of materials which are readily decomposable in the marine environment may be disposed of under the general permit set forth in this Section at the site at which disposal of human remains is authorized.

(d) All burials conducted under this general permit shall be reported within 30 days to the Regional Administrator of the Region from which the vessel carrying the remains departed.

§ 229.2 Transport of target vessels.

(a) The United States Navy is hereby granted a general permit to transport vessels from the United States or from

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any other location for the purpose of sinking such vessels in ocean waters in testing ordnance and providing related data subject to the following conditions:

(1) Such vessels may be sunk at times determined by the appropriate Navy official;

(2) Necessary measures shall be taken to ensure that the vessel sinks to the bottom rapidly and permanently, and that marine navigation is not otherwise impaired by the sunk vessel;

(3) All such vessel sinkings shall be conducted in water at least 1000 fathoms (6000 feet) deep and at least 50 nautical miles from land, as defined in § 229.1(b); and

(4) Before sinking, appropriate measures shall be taken by qualified personnel at a Navy or other certified facility to remove to the maximum extent practicable all materials which may degrade the marine environment, including without limitation, (i) emptying of all fuel tanks and fuel lines to the lowest point practicable, flushing of such tanks and lines with water, and again emptying such tanks and lines to the lowest point practicable so that such tanks and lines are essentially free of petroleum, and (ii) removing from the hulls other pollutants and all readily detachable material capable of creating debris or contributing to chemical pollution.

(b) An annual report will be made to the Administrator of the Environmental Protection Agency setting forth the name of each vessel used as a target vessel, its approximate tonnage, and the location and date of sinking.

§ 229.3 Transportation and disposal of vessels.

(a) All persons subject to Title I of the Act are hereby granted a general permit to transport vessels from the United States, and all departments, agencies, or instrumentalities of the United States are hereby granted a general permit to transport vessels from any location for the purpose of disposal in the ocean subject to the following conditions:

(1) Except in emergency situations, as determined by the U.S. Army Corps of Engineers and/or the U.S. Coast Guard, the person desiring to dispose of a vessel under this general permit shall, no later than one month prior to the proposed disposal date, provide the following information in writing to the EPA Regional Administrator for the Region in which the proposed disposal will take place:

(i) A statement detailing the need for the disposal of the vessel;

(ii) Type and description of vessel(s) to be disposed of and type of cargo normally carried;

(iii) Detailed description of the proposed disposal procedures;

(iv) Information on the potential effect of the vessel disposal on the marine environment; and

(v) Documentation of an adequate evaluation of alternatives to ocean disposal (i.e., scrap, salvage and reclamation).

(2) Transportation for the purpose of ocean disposal may be accomplished under the supervision of the District Commander of the U.S. Coast Guard or his designee.

(3) Except in emergency situations, as determined by the U.S. Army Corps of Engineers and/or the District Commander of the U.S. Coast Guard, appropriate measures shall be taken, prior to disposal, by qualified personnel to remove to the maximum extent practicable all materials which may degrade the marine environment, including without limitation, (i) emptying of all fuel lines and fuel tanks to the lowest point practicable, flushing of such lines and tanks with water, and again emptying such lines and tanks to the lowest point practicable so that such lines and tanks are essentially free of petroleum, and (ii) removing from the hulls other pollutants and all readily detachable material capable of creating debris or contributing to chemical pollution.

(4) Except in emergency situations, as determined by the U.S. Army Corps of Engineers and/or the U.S. Coast Guard, the dumper shall, no later than 10 days prior to the proposed disposal date, notify the EPA Regional Administrator and the District Commander of the U.S. Coast Guard that the vessel has been cleaned and is available for inspection; the vessel may be transported for dumping only after EPA and the Coast Guard agree that the requirements of paragraph (a)(3) of this Section have been met.

(5) Disposal of these vessels shall take place in a site designated on current nautical charts for the disposal of wrecks or no closer than twenty-two kilometers (twelve miles) from the nearest land and in water no less than fifty fathoms (three hundred feet) deep, and all necessary measures shall be taken to ensure that the vessels sink to the bottom rapidly and that marine navigation is not otherwise impaired.

(6) Disposal shall not take place in established shipping lanes unless at a designated wreck site, nor in a designated marine sanctuary, nor in a location where the hulk may present a hazard to commercial trawling or national defense (see 33 CFR 205).

(7) Except in emergency situations, as determined by the U.S. Army Corps of Engineers and/or the U.S. Coast Guard, disposal of these vessels shall be performed during daylight hours only.

(8) Except in emergency situations, as determined by the U.S. Army Corps of Engineers and/or the District Commander of the U.S. Coast Guard, the Captain-of-the-Port (COTP), U.S. Coast Guard, and the EPA Regional Administrator shall be notified forty-eight (48) hours in advance of the proposed disposal. In addition, the COTP and the EPA Regional Administrator shall be notified by telephone at least twelve (12) hours in advance of the vessel's departure from port with such details as the proposed departure time and place, disposal site location, estimated time of arrival on site, and the name and communication capability of the towing vessel. Schedule changes are to be reported to the COTP as rapidly as possible.

(9) The National Ocean Survey, NOAA, 6010 Executive Blvd., Rockville, MD 20852, shall be notified in writing, within one week, of the exact coordinates of the disposal site so that it may be marked on appropriate charts.

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Part III

Environmental Protection Agency

Guidelines for Specification of Disposal Sites for Dredged or Fill Material

APPENDIX H

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ENVIRONMENTAL PROTECTION AGENCY

[40 CFR Part 230]

[FRL 1241-3]

Guidelines for Specification of Disposal Sites for Dredged or Fill Material

AGENCY: Environmental Protection Agency.

ACTION: Proposed regulation.

SUMMARY: These Guidelines revise and clarify the September 5, 1975 interim final Guidelines regarding discharge of dredged or fill material into waters of the U.S. in order to:

(1) reflect the 1977 Amendments of section 404 of the Clean Water Act;

(2) correct inadequacies in the interim final Guidelines by filling gaps in explanations of unacceptable adverse impacts on aquatic and wetland ecosystems and by requiring documentation of compliance with the Guidelines; and

(3) produce a final rulemaking document.

The existing interim final Guidelines will remain in effect until the effective date of these revised Guidelines.

DATES: All comments received on or before November 19, 1979 will be considered.

ADDRESS: Send written comments to: Kenneth Mackenthun, Criteria and Standards Division, Office of Water and Waste Management, (WH-558), U.S. Environmental Protection Agency, 401 M Street, SW., Washington, D.C. 20460. Each person submitting a comment should include his or her name and address and give reasons for any recommendations. A copy of all public comments will be available for inspection and copying at the EPA Public Information Reference Unit, Room 2922 (EPA Library), 401 M Street, SW., Washington, D.C. 20460.

FOR FURTHER INFORMATION CONTACT: Kenneth Mackenthun, 202-755-0100.

Supplementary Information

Background

The Federal Water Pollution Control Act (FWPCA) Amendments of 1972 established a new permit program for the discharge of dredged or fill material in navigable waters. Under section 404 of the FWPCA, the Corps of Engineers (COE) specifies disposal sites based on application of Guidelines developed by the Administrator of EPA in conjunction with the Secretary of the Army acting through the Chief of Engineers. (Hereinafter, "404(b)(1) Guidelines" or "Guidelines"). In any case where such Guidelines alone would prohibit the specification of a disposal site, the Corps may still specify a site through the additional application of the economic impact of the site on navigation and anchorage. The Administrator may deny or restrict the specification or use of any disposal when he determines, after the opportunity for hearing and consultation with the COE, that a discharge will have unacceptable adverse effect on municipal water supplies, shellfish beds and fishery areas (including spawning and breeding areas) wildlife, or recreational areas.

The interim final Guidelines recognized that all aspects of aquatic ecosystems, including wetlands, may be affected by the discharge of dredged or fill material. The concept of critically important components of sites of the aquatic environment was set forth in the Guidelines and nine such components were identified. The Guidelines emphasized the importance of wetlands as a component of the aquatic environment. They identified the values associated with wetlands and specified methods of preventing or minimizing impacts of the discharge of dredged or fill material on wetlands. The interim final Guidelines also set out procedures for testing material proposed for discharge in order to predict unacceptable impact on aquatic organisms.

The COE regulations were revised, extensively reorganized, and repromulgated on July 19, 1977. The regulations established certain "Nationwide" permits in accordance with the concept of General or categorical permits in § 230.6 of the interim final guidelines. In enacting section 404(e) of the 1977 Clean Water Act Amendments, Congress also approved the use of general permits, including nationwide permits, to minimize administrative involvement in activities that have minimal individual or cumulative adverse impact on the aquatic and wetlands ecosystems. Greater use of General Permits is expected in the future.

Section 404 became the focus of considerable debate in the 95th Congress. In December 1977, the FWPCA was amended and substantial changes were made in section 404. The amendments specified several additional applications of the Guidelines: (1) General permits shall be based on 404(b)(1) Guidelines; (2) a State desiring to administer permit program in certain waters must use and assure compliance with the 404(b)(1) Guidelines; (3) the Administrator of EPA can withdraw a State program or prevent a State from issuing a permit if the State fails to comply with the 404(b)(1) Guidelines; (4) in order for the construction of a Federal project to be exempted under section 404(r), its EIS must include consideration of the 404(b)(1) Guidelines, and (5) best management practices prepared under a 208(b)(4) (B) and (C) statewide regulatory program must comply with the 404(b)(1) Guidelines.

Although the Clean Water Act uses the term "Guidelines" in section 404(b)(1), the requirements placed on their use in the Amendments demonstrate that they are regulatory in nature.

The interim final guidelines incorporated by reference the definition for "discharge or fill material" among other definitions from 33 CFR 209.120(d). Sanitary landfills were included among the examples of discharges of fill material into navigable waters. Current COE regulations (33 CFR 320) require a section 404 permit for fill material discharged into waters of the U.S. to construct a levee or dike for the rentention of solid waste. The discharge of solid waste within such retention structures is currently subject to regulation under section 402 of the Clean Water Act. Sanitary landfills in waters of the U.S. are now the subject of policy discussions among organizational units of EPA and the Corps of Engineers, with a view to the possibility of consolidating the regulation of such activities under a single regulatory authority.

Purpose and Content of the Guidelines

The purpose of the section 404(b)(1) Guidelines is to carry out the objective of the Act: to restore and maintain the chemical, physical, and biological integrity of the Nation's waters. To accomplish that objective, it is necessary to control degradation of waters of the U.S. attributable to the discharge of dredged or fill material. The Guidelines are concerned with aquatic ecosystems because all parts of the systems are related and disruption of one part can cause changes in other parts. In many cases, such changes are foreseeable.

Waters of the U.S. vary greatly with respect to biogeographical characteristics. In addition, the use of those waters varies around the Nation as do the methods of discharging dredged or fill material. These and other variations make it unrealistic at this time to arrive at numerical criteria or standards for toxic or hazardous substances to be applied on a nationwide basis. The susceptibility of

wetlands to destruction by purely physical placement of dredged or fill material and the wide national variation in amount and quality of wetlands further complicate the problem of arriving at nationwide standards. As a result, the Guidelines concentrate on specifying the tools to be used in evaluating and testing the impact of dredged or fill material discharges on waters of the U.S.

The Guidelines also explain the appropriate use of these tools in particular circumstances to ensure that the objectives of the Act are met without unnecessary burden. Comments interspersed in the text provide further explanations and examples as appropriate.

Guideline Organization

The Guidelines are organized into nine Subparts, each of which is subdivided into numbered sections. After presenting general material such as policy and definitions, the Subparts deal with compliance; general physical, chemical and biological evaluations and tests and determinations; physical and chemical components of the aquatic and wetlands environment; special aquatic and wetlands sites; communities and populations of organisms dependent on water quality; human use characteristics; habitat development and restoration of water bodies; and general provisions, including consideration of cumulative and secondary impacts on the aquatic ecosystem. Factors that must be considered for every permit application are grouped into Subparts A through D. Factors that are important, but are not pertinent for every site for which a permit application is made, are grouped in Subparts E through G. Subpart H treats special processes and procedures. Material in Subparts D through G (chemical, physical, and biological characteristics of special aquatic environments and their human uses) has been organized in terms of values, possible loss of values due to discharge of dredged or fill material, methods of avoiding loss of values, and determinations that should be made in arriving at a finding of compliance with the Guidelines.

Documentation of Guideline Application and Compliance

Specific documentation is important to the permit applicant, the permitting authority, and any reviewing authority to ensure an understanding of the basis for each decision to allow, condition, or prohibit a discharge through application of the Guidelines. Documentation of information is required for: (1) facts and data gathered in the evaluation and testing of the extraction site, the material to be discharged, and the disposal site; (2) factual determinations regarding changes that can be expected at the disposal site if the discharge is made as proposed; and (3) findings regarding compliance with regulatory conditions involving mandatory standards, prevention of adverse impacts, and minimization of adverse impacts where practicable.

Documentation provides a record of actions taken that can be evaluated for adequacy and accuracy and ensures consideration of all important impacts in the evaluation of a permit application. The specific requirements for documentation in any given case depend on the level of investigation necessary to provide sufficient information about the extraction site, the material to be discharged, and the disposal site to provide a basis for a reasonable understanding of the impact on the aquatic and wetlands ecosystems.

Major Issues

Several important areas of the Guidelines involve important questions of policy which give rise to possible alternative treatments. This Preamble identifies for each issue the approach that has been selected and incorporated into the Guidelines and explains why this approach was selected. However, it should be noted that there remains an opportunity to alter these positions prior to final publication based upon analysis of informed public comment.

Issue Number 1. What are the requirements and limitations for the evaluation and consideration of practicable alternatives? [230.10(a)]

a. Is it necessary to consider additional alternatives where an initial evaluation under 404(b)(1) Guidelines shows that there would be adverse impacts from the initially proposed alternative but that those impacts could be judged "acceptable" within the context of 404(b)(1) Guidelines?

Approach Used in the Guidelines: The proposed revisions to the Guidelines take the position that even where the initial 404(b)(1) Guidelines evaluation shows that impacts fall within an "acceptable" range, it remains necessary to examine and consider practicable alternatives with even less damaging environmental impacts.

Reasons for Selecting This Approach: The 403(c) criteria (on which the Guidelines are statutorily required to be based) include "other possible locations and methods of disposal or recycling of pollutants including land-based alternatives." A national goal of the Clean Water Act is "that the discharge of pollutants into the navigable waters be eliminated by 1985." Moreover, the National Environmental Policy Act (NEPA) also imposes an obligation upon Federal agencies to interpret and administer regulations in accordance with the policies of NEPA. The courts have held repeatedly that the consideration of alternatives is the "linchpin" of NEPA. If impacts on wetlands or other special aquatic resources are to be prevented or minimized, then it is essential to identify least damaging practicable alternatives for the permitting authority's consideration in determining whether, and on what terms, the permit should be issued.

Further, in connection with wetlands, EPA Administrator's Statement Number 4, Protecing Our Nation's Wetlands, states that it is the Agency's policy in its decision process to preserve and protect wetlands from damaging misuses. Implementation of this policy requires that alternatives be evaluated and that the least damaging alternative be selected where practicable. Executive Order 11990, Protection of Wetlands, provides an additional foundation for requiring a broad consideration of alternatives in programs intended to protect wetlands through its directive for Federal agencies to take action to minimize the destruction, loss, (or) degradation of wetlands, and to preserve and enhance the natural and beneficial value of wetlands in carrying out programs affecting land use, including but not limited to water and related land resource planning and regulating and licensing activities.

Although the Executive Order does not apply to individual permit actions by private parties in non-Federal wetlands, it does apply to regulations which affect wetlands, such as the 404(b) guidelines.

b. What range of alternatives must be considered?

Approach Used in the Guidelines: The proposed revision requires that the evaluation of practicable alternatives must take into account *all* alternatives which meet the criteria of practicability, which as used here includes consideration of economic, technical, and logistical feasibility. The spectrum of alternatives considered should include both so-called "internal" alternatives (modifications to the activity within the scope of the application itself such as timing of discharge, alternate locations at the same general site, mitigating measures, etc.) and "external" alternatives (such as major modifications in the nature of the proposed activity or change in site *outside* the site proposed in the permit application.

Reasons for Selecting This Approach: External alternatives are not practicable if they fail to achieve the fundamental purpose of the proposed activity.

Consideration of "internal" alternatives needs little justification beyond the application of common sense. If the applicant has within his immediate capability an alteration in the project which will lessen the environmental impact, yet remain practicable, he should certainly implement it. Moreover, it is entirely possible that such an evaluation might even result in a *lower* cost project when such a broader evaluation is carried out. This is particularly plausible when considering the problems of erosion, flood damage, materials decomposition, etc., which are often of concern with construction in or near the water.

Support for the proposition that alternatives should also include "external" factors comes from: (1) section 403 of the Act; (2) NEPA; and (3) past practice. Section 403(c)(1)(F) specifically refers to other possible locations and methods of disposal, without limitations. Also, cases under NEPA and CEQ regulations, which are relevant by analogy, have held that even alternatives which are outside the existing authority of the agency must be considered. In addition, several 404 cases have involved consideration of alternatives sites not owned by the applicant. Discharges into the waters of the U.S. are allowed only through a permit process under which the applicant's interest in conducting a discharge is subject to the national interest in maintaining the integrity of the Nation's waters. However, it should be noted that the intent here is not to require consideration of the extreme or the absurd, but only those alternatives which are truly practicable. It is expected that the "Rule of Reason" shall be applied in the context of this alternatives test. The size of the activity and its impact will certainly be major factors in determining how far the search for alternatives should go.

c. Must the least damaging practicable alternative be selected, and can any alternative be accepted so long as it does not have "unacceptable" impacts?

Approach Used in the Guidelines: Generally the least damaging, yet practicable, alternative should be selected. In the case of discharges of *fill* material into *wetlands*, water dependency for the proposed activity should be considered a mandatory condition of compliance except upon the finding that other siting or construction alternatives are not practicable and the proposed fill will not cause a permanent adverse disruption to beneficial water quality uses of the system.

Reasons for Selecting This Approach: Support for the proposition that the least damaging alternative should be selected can be found in part in the statement of goals of the Clean Water Act. Section 101 provides that it is the goal of the Act to Maintain the chemical, physical, and biological integrity of the Nation's waters and to eliminate the discharge of pollutants (including dredge material, rock, and sand as defined in section 502) into the navigable waters. A selection of a more damaging practicable alternative over a less damaging one would be inconsistent with those goals particularly when the less damaging alternative is obvious and easily identified. Moreover, the mere requirement that alternatives be considered implies that where practicable, the less harmful choice will be made. Otherwise, the consideration of alternatives would be a mere formality.

d. Is identification of a least damaging practicable alternative on the basis of the section 404(b)(1) evaluation decision as to the outcome of the NEPA and/or Public Interest Review (PIR) alternatives evaluation?

Approach used in the Guidelines: The alternatives evaluation within the section 404(b)(1) Guidelines is separate and distinct from the NEPA and PIR alternatives evaluation. If the § 404(b)(1) review leads to a finding in favor of specification of a proposed site, that finding does not obviate the requirement for further alternatives evaluation of the proposed work via the requirements of NEPA and the PIR.

Reason for Selecting this Alternative: The requirements of NEPA and PIR take into account a broader range of environmental and other factors (e.g. air quality impacts, esthetics, of extent of public need for the proposed project) than those required to be considered by the Guidelines. Accordingly, in cases where the Guidelines themselves do not preclude the specification of a proposed disposal site, the more comprehensive requirements of NEPA and PIR may nevertheless lead to a decision to deny the requested permit.

Issue Number 2. Are water quality standards violation and violations of 307(a) standards the only grounds for findings of unacceptable adverse impacts within the context of 404(b)(1) Guidelines or can such findings be based upon a broader consideration of effects on the aquatic ecosystem?

Approach Used in the Guidelines: Any finding of acceptability of impact within the context of 404(b)(1) Guidelines (i.e., specification or non-specification of the site) *must* be made on the basis of *all* of the conditions of compliance under these 404(b)(1) Guidelines. That is, it must be based upon determinations of impact on the aquatic ecosystem, including such factors as wildlife habitat, commercial fisheries, and modifications of currents, as well as water quality and toxic pollutant standards.

Reasons for Selecting This Approach: The language of section 404(b)(1) itself supports a broad view of the impacts to be addressed in the Guidelines. That section says that the Guidelines shall be based on criteria "comparable" to the criteria in section 403(c). Thus, the section 404(b)(1) Guidelines are intended to be as broad in scope as the section 403 criteria. The section 403 criteria clearly include ecological concerns above and beyond the baseline numercial parameters of water quality (See Section 403(c)(1)(B), (C), and (G)). Moverover, section 404(b)(1) says that the Guidelines are to be based on criteria *comparable* to those of section 403. Thus, Congress recognized that the material to be disposed of under section 404 might be different from materials typically disposed of at sea and that section 404 waters might be affected somewhat differently than the seas. Finally, the wording of section 404(b) makes it clear that a site may be prohibited on the basis of such Guidelines "alone," implying that the broader considerations of ecological effect were to be dealt with in the context of the 404(b) decisions.

The fact that section 404(c) [1] goes beyond strict water quality consideration also supports the scope of the (b)(1) Guidelines. On its face, 404(c) is not limited to considerations of water quality since it refers to "unacceptable adverse effect on municipal water supplies, shellfish beds and fishery areas (including spawning and breeding areas), wildlife or recreational areas." In addition, since section 404(c) can be used before there is an application for a permit, it clearly contemplates consideration of the ecological characteristics of the site alone, wholly apart from the contaminants in a particular discharge.

The breadth of section 404(c) is relevant because of relationship between section 404(b) and (c). Senator Muskie's opening statement of the 1972 Conference Report explains that EPA has two opportunities for imput, apart from 309 authority; first, EPA develops

[1] Section 404(c) allows the Administrator to veto a site if a discharge of dredged or fill material will have an "unacceptable adverse effect" on enumerated resources.

the section 404(b)(1) Guidelines which serve as a general, advance guidance for the 404 program; second, EPA has an opportunity to police the application of those Guidelines by evaluating the ecologic implications of a particular permit under 404(C) (Legislative History of the Federal Water Pollution Control Act prepared by the Congressional Research Service of the Library of Congress. Vol. 1, page 177). If, on the other hand, the section 404(b)(1) Guidelines were narrower in scope than section 404(c), the permitting authority would continually be issuing permits which, although admittedly in compliance with EPA's Guidelines, would be subject to veto by the Administrator. It seems improbable that Congress intended the program to operate in such a manner.

Another indication that the section 404(b)(1) Guidelines were expected to include environmental effects generally can be found in section 404(e). That section allows the Corps to issue general permits when it determines that the separate and cumulative impacts of a category of activities will have minimal adverse "environmental" effects. Where the seprate of cumulative "environmental" effects are more than minimal, the Corps must apply the section 404(b)(1) Guidelines to each discharge individually instead of to the categroy. If the Guidelines were limited to water quality and toxics, there would be no reason to consider "environmental" impacts in deciding whether it would be appropriate to forego section 404(b)(1) scrutiny of individual projects.

Issue Number 3: How should the requirements for testing be structured?

Approach Used in the Guidelines: The proposed regulation includes procedures for physical, chemical, and biological testing of dredged or fill material proposed to be discharged into the waters of the United States. These proposed procedures are essentially identical to the testing procedures of the interim final guidelines of September 5, 1975 (40 CFR 230, Section 4-1). Within 30 days of the date of this proposal, detailed information will be provided in the Federal Register concerning possible approaches to revision of section 404(b)(1) testing procedures soliciting broad public comment on this aspect of the section 404(b)(1) evaluation process.

Reason for Selecting this Approach: Since publication of the interim final guidelines, experience in their implementation and the results of ongoing research have indicated the need to revise the testing procedures to improve both their operational efficiency and technical quality. Several approaches to modification of the current procedures have been considered and alternative approaches to the testing issue have been developed in considerable detail. These are still being prepared for public review. In order for this important issue to receive the most thorough focus and broadest comment, the testing issue will be prepared as a separate item for public comment within 30 days. Following a consideration of comments from this special publication, the modified testing approach will be proposed for inclusion in the Guidelines.

Issue Number 4. What is the relationship between sections 404 and 311?

Approach Used in the Guidelines: Section 311 of the Clean Water Act imposes reporting requirements, cleanup liabilities, and civil penalties in the event of spills of oil or hazardous substances in amounts which may be harmful. Both the identity of the hazardous substances and the amounts which may be harmful are specified in regulations. To date, 299 substances have been designated as hazardous. The section 404(b)(1) Guidelines have been drafted with these requirements in mind. However, because of the difficulty in measuring the exact amount of particular hazardous substances in dredged or fill material and because the amount which may actually be harmful may be vastly different from a spill of concentrated material when the substance is contained in dredged or fill material, we did not simply incorporate quantities in the section 311 regulations. The approach described below is taken to ensure the protection of the waters.

Reasons for Selecting This Approach: Section 230.10(c) provides that no discharge of dredged or fill material will be permitted if it will have an unacceptable adverse impact on the waters of the United States. Subsequent sections ensure that the impact of any discharge will be fully understood before any decision is made to permit the discharge. For example, under § 230.23(f), the permitting authority is required to make a determination of the "potential for acute or chronic effects on aquatic and wetland organisms, including bioaccumulation, as a result of the biological availability of pollutants in the solid, liquid, or suspended particulate phases."

Before making that determination, the permitting authority, pursuant to § 230.22, must consider the likelihood that the dredged or fill material in question is a carrier of pollutants. If this inquiry indicates that pollutants, such as 311 hazardous substances, are likely to be present, then the permitting authority is required to undertake specified tests as provided in § 230.23 to determine the effect of the proposed discharge at the proposed disposal site. The Guidelines state explicitly that one circumstance to be considered in assessing the need for testing is any history of spills of petroleum products or substances designated as hazardous under section 311. Thus, under the section 404(b)(1) Guidelines, a discharge of dredged or fill material containing more than the designated quantity of hazardous substances could be permitted *only* where there is prevailing evidence that the discharge will in fact not be harmful.

Public Participation

On September 7, 1978, the Office of Water Planning and Standards distributed for limited review a draft of the section 404(b)(1) Guidelines. More than 300 copies were distributed to Federal, State and local agencies, environmental/conservation groups, trade associations, civic groups and other interested parties and individuals. Thirty-two responses were received on the Guidelines and the following synthesis is representative of the comments received.

1. *Comment:* Several commenters stated that the Guidelines do not distinguish between regulatory and background materials, and recommended that the Guidelines should be divided into two sections, namely background on the effects of discharges on aquatic biota, wetlands, water quality, etc., and the specific regulatory procedures to evaluate those effects.

Answer: The Guidelines generally are physically divided into a procedural assessment part and an ecosystems guidance part, but it is not possible conceptually to divorce one from the other, since the two sections must be used in conjunction to properly evaluate a section 404 permit. To separate the two parts in a manner which subordinates the ecosystems guidance part would imply that the latter is not important or meaningful in the section 404 (b)(1) evaluation. This would be contrary to the purpose for which the ecosystems guidance is provided, namely to ensure that an adequately rigorous evaluation is carried out. This guidance also helps to ensure consistency of the evaluation process by providing a structured format for consideration of each of the special systems treated.

2. *Comment:* One commenter stated that activities authorized under General Permits should not require individual review and approval by regulatory agencies.

Answer: This comment may reflect confusion over the operational effect of the Guidelines. The Guidelines do not require review under the Guidelines when an individual proposes to undertake an activity covered by a General Permit. However, the establishment of a General Permit itself must be based on an assessment under the Guidelines of the activities to be covered.

3. *Comment:* Several commenters suggested that the Guidelines failed to adequately protect wetlands, and that EPA should do more to prevent the destruction of wetlands in the U.S.

Answer: The section 404 program in general and the Guidelines in particular are designed specifically to control the discharge of dredged or fill material into waters of the U.S., including wetlands. In this sense, section 404 and the Guidelines do not constitute a full-scale "wetlands protection law." However, the Guidelines do recognize wetlands as a particularly important component of the waters of the United States. This revision is designed to maintain that emphasis, but also to emphasize other aquatic areas that have values deserving special consideration.

4. *Comment:* One commenter strongly objected to the presumption that toxic pollutants are present in dredged material unless demonstrated otherwise by detailed testing procedures of the Guidelines.

Answer: Testing procedures for toxic substances have been incorporated into the Guidelines to ensure a healthy human environment and to prevent damage to the aquatic ecosystem and the organisms which occupy it. However, this testing is not required for every discharge. Indeed, it will be the exception, not the rule. The Guidelines have been structured in such a way as to provide for the elimination from chemical testing for those discharges where the probability of contamination is reasonably believed to be low. This "general evaluation" of § 230.22 is based upon such factors as proximity of the extraction site to known sources of pollution, potential routes of pollutant entry to the extraction site, and similarity of the material to be discharged to that comprising the substrate at the discharge site.

5. *Comment:* The "water dependency test" of § 230.10(e) is too weak as currently drafted. Although the requirement exists that the "* * * activity associated with the fill must have direct access or proximity to, or be located in, the water resource in question to fulfill its basic purpose * * *", it provides the applicant an easy escape if * * * "other site or construction alternatives are not practicable." Such a wording provides no regulatory controls beyond those already embodied in § 230.10(a)-(d).

Answer: EPA essentially agrees that the above-quoted draft language provided little specific regulatory authority except to highlight the presumption that fills into wetlands and other special areas are less likely to be found "acceptable". Accordingly, we have revised § 230.10(e) to clearly establish upon applicants a requirement to demonstrate a need for the basic purpose of proposed fill activities in wetlands or other special aquatic areas. This test is in addition to other evaluation requirements (e.g. alternatives, mitigation) of the Guidelines. The effect of this change is to complement and strengthen the overall precept of the Guidelines that adverse impacts upon valuable wetland areas should be minimized while avoiding the imposition of an unduly stringent generic restriction against all activities (e.g., primary residence housing in large geographical areas dominated by wetlands) involving filling within such areas.

Regulatory Analysis

Since these proposed Guidelines serve principally to revise the existing interim final Guidelines and since the operating regulations for the 404 Program are the Corps regulations, the basic costs and impacts of the Federal dredge and fill regulatory program derive from regulations already promulgated and in effect. However, it may be anticipated that some incremental costs and impacts may derive from these proposed Guidelines since their application will result in some changes in the manner in which proposed discharges are evaluated and perhaps in the ultimate specification decision. It is difficult or impossible to predict the net direction and magnitude of such incremental costs and impacts, since there may be either increases or decreases depending upon the specific case. On the one hand, these proposed Guidelines may require more costly documentation and/or lead to more permit denials or restrictive conditions. On the other hand, however, the more clearly drawn general evaluation procedures (which will excuse most small discharges from chemical testing) may reduce permit-processing costs and lead to fewer denials on the basis of purely speculative fears of potentially large environmental impact. In addition, the more carefully designed evaluation process should reduce the chance of "mistakes" requiring costly cleanup.

The overall economic effect of these regulations will depend upon such site-specific factors as the size and complexity of the project, the degree and nature of public interest, the general state of environmental quality, and the operating mode of the local regulatory authority. Only after several years of experience in operating the permit program under these Guidelines can we attempt to meaningfully assess the incremental difference. In conclusion, we have no reason to believe at present that the proposed Guidelines are significant regulations within the meaning of Executive Order 12044, and thus no Regulatory Analysis is required.

Subpart A—General

§ 230.1 Purpose and policy.

(a) The purpose of these Guidelines is to restore and maintain the chemical, physical, and biological integrity of the waters of the U.S. through the control of discharges of dredged and fill material.

(b) Congress has expressed a number of policies in the Clean Water Act. These Guidelines are intended to be consistent with and to implement those policies. While the guidelines have been written to stand by themselves, the user of the Guidelines is encouraged to keep the policies expressed in the Clean Water Act in mind to ensure the reasonable application of the Guidelines. The attention of the user is particularly directed to the policies expressed in the following sections of the Act: Section 101 (declaration of goals and policy), section 208 (area-wide management), section 301 (effluent limitations,), section 303 (water quality standards), section 307(a) (toxics), section 311 (hazardous substances), section 401 (certification), section 402 (National Pollution Discharge Elimination System), section 403 (ocean discharge criteria), section 404 (permits for dredged and fill material), and the definitions contained in section 502.

(c) Fundamental to the use of these Guidelines is the precept that dredged or fill material should not be discharged into the aquatic ecosystem, including wetlands, unless it can be demonstrated that such a discharge is necessary and will not have an unacceptable adverse impact either individually or in combination with known and/or probable impacts of other activities affecting the ecosystems of concern (See § 230.72). This precept places the burden of proof on the discharger to demonstrate that a proposed discharge should be permitted.

(d) From a national perspective, the degradation or destruction of aquatic resources by filling operations in wetlands is considered to be among the most severe environmental impacts covered by these guidelines. The guiding principle should be that destruction of highly productive wetlands may represent and irreversible loss of a valuable aquatic resource.

§ 230.2 Applicability.

(a) The Guidelines have been developed by the Administrator of the Environmental Protection Agency in conjunction with the Secretary of the Army acting through the Chief of Engineers under section 404(b)(1) of the Clean Water Act (33 U.S.C. 1344). The Guidelines are applicable to the specification of disposal sites for discharges of dredged or fill material into waters of the United States, and include:

(1) The regulatory program of the U.S. Army Corps of Engineers under sections 404 (a) and (e) of the Act (see 33 CFR 320, 323, 325);

(2) Permit programs of States approved by the Administrator of the Environmental Protection Agency in accordance with sections 404 (g) and (h) of the Act (see 40 CFR 122, 123 and 124);

(3) The civil works program of the U.S. Army Corps of Engineers to which the permit procedures of the regulatory program in (1) do not apply (see 33 CFR 209.145 and section 150 of Pub. L. 94-587, Water Resources Development Act of 1976);

(4) Activities controlled by best management practices implemented by approved Statewide dredged or fill material regulatory programs under section 208(b)(4) (B) and (C) of the Act (see 40 CFR 35.1560);

(5) The planning and evaluation of those Federal construction projects specifically authorized by Congress which meet criteria specified in section 404(r) of the Act.

(b) These Guidelines will be applied in the review of proposed discharges of dredged or fill material into navigable waters which lie inside the baseline from which the territorial sea is measured and the discharge of *fill* material into the territorial sea pursuant to the procedures specified in 33 CFR 320 and 33 CFR 209.145. The discharge of *dredged* material into the territorial sea is governed by the Marine Protection, Research, and Sanctuaries Act of 1972, Pub. L. 92-532, and regulations and criteria issued pursuant thereto (40 CFR 227, "Ocean Dumping Final Regulations and Criteria", and the International Convention for Prevention of Marine Pollution by Dumping of Wastes and Other Matter (London Convention) and to which the United States is one of the contracting parties).

(c) Guidance interpreting these Guidelines may be prepared jointly by EPA and the Corps at the National or regional level from time to time. No modifications to the basic application, meaning, or intent of these Guidelines will be made without rulemaking by the Administrator under the Administrative Procedure Act. (5 U.S.C. 551 *et seq.*)

§ 230.3 Definitions.

For purposes of this Part, the following terms shall have the meanings indicated:

(a) The term "Act" means the Clean Water Act (also known as the Federal Water Pollution Control Act-FWPCA) Pub. L. 92-500, as amended by Pub. L. 95-217, 33 U.S.C. 1251, et seq.

(b) The term "disposal site" means a unit of the waters of the U.S. enclosed within specific boundaries consisting of a water surface area (when present), a volume of water (when present), and a substrate area. In the case of wetlands on which water is not present at the time at which the disposal is contemplated, the disposal site consists of the wetland surface area.

(c) The term "discharge point" means the point within the disposal site at which the dredged or fill material is released.

(d) The term "dilution and dispersion zone" means the volume of water where discharged material and water mix.

Comment: The term "mixing zone" has been used in a number of different ways during the implementation of the Act and other Acts and in discussions concerning Section 404. To avoid confusion, the term "dilution and dispersion zone" is used in these Guidelines. This term refers to the purely physical and chemical processes of mixing the dissolved and suspended particulate components of discharged material with receiving water. The boundary of this zone is the point at which dissolved material and suspended particulates have been sufficiently diluted or dispersed so as to exhibit physical and chemical characteristics substantially the same as those of the receiving water. Therefore, this term differs from the concept of "mixing zone" which has been used elsewhere to mean the volume of the water mass in which discharged material is *allowed* to exceed acceptable levels (such as appropriate water quality standards). In these guidelines, the water mass in which discharged material is allowed to exceed acceptable levels while initial dilution and dispersion take place is described by use of the term "disposal site."

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(e) The term "desposition zone" means the space on the substrate where discharged material accumulates.

(f) The term "constituents" means the chemical or radiological substances, solids, and organisms associated with dredged or fill material.

(g) The term "pollution" means the man-made or man-induced alteration of the chemical, physical, biological, or radiological integrity of the water.

(h) The term "toxic pollutant" means any substance on the list of toxic pollutants promulgated on January 31, 1978 (43 FR 4109) or on any subsequent list promulgated pursuant to section 307(a)(1) of the Act.

(i) The term "carrier of contaminant" means dredged or fill material that is contaminated by chemical, biological, or radiological substances in a form that can be incorporated into or ingested by and harm or otherwise contaminate aquatic organisms, consumers of aquatic organisms, or users of the aquatic environment.

(j) The term "solid phase" means the portion of dredged or fill material that, when discharged into water, retains its solid form and settles on the substrate in solid form.

(k) The term "liquid phase" means the portion of dredged or fill material that, when discharged into water, is dissolved and remains in solution as it passes through the water column.

(l) The term "suspended particulate phase" means the portion of dredged or fill material that, when discharged into water, disperses in the water column as suspended particles, usually the size of silt (63 microns or one-sixteenth of a millimeter) or smaller.

(m) The term "acute toxicity" means a short-term effect of a toxic pollutant that typically results in death of the exposed organisms. Acute toxicity can be expressed as the lethal concentration for a stated percentage of organisms tested, or the reciprocal, which is the tolerance limit of a percentage of surviving organisms. (Acute toxicity for aquatic organisms generally has been expressed for 24- to 96-hour exposures).

(n) The term "chronic toxicity" means the effect of toxic pollutants upon organisms through an extended time period. Chronic toxicity may be expressed in terms of an observation period equal to the lifetime of an organism or to the time span of more than one generation. Some chronic effects may be reversible, but most are not. Chronic effects often occur in the species population rather than in the individual.

(o) The terms "aquatic environment" and "aquatic ecosystem, including wetlands" mean waters of the U.S. that serve as habitat for interrelated and interacting communities and populations of plants and animals.

(p) The term "practicable" means feasible after taking into consideration economics, technology, and logistical factors.

(q) The term "pollutant" means dredged spoil, solid waste, incinerator residue, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt, and industrial, municipal, and agricultural waste discharged into water.

Comment: The legislative history of the Act reflects that "radioactive materials" as included within the definition of "pollutant" in section 502 of the Act means only radioactive materials which are not encompassed in the definition of source, byproduct, or special nuclear materials as defined by the Atomic Energy Act of 1954, as amended, and regulated under the Atomic Energy Act. Examples of radioactive materials not covered by the Atomic Energy Act and, therefore, included within the term "pollutant", are radium and accelerator produced isotopes. See *Train v. Colorado Public Interest Research Group, Inc.*, 426 U.S. 1 (1976).

(r) The term "wetlands" means those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.

(s) "Navigable waters" is defined in section 502(7) of the Act to mean "waters of the United States, including the territorial seas." This term includes but is not limited to:

(1) All waters which are currently used, or were used in the past, or may be susceptible to use in interstate or foreign commerce, including all waters which are subject to the ebb and flow of the tide;

(2) Interstate waters, including wetlands;

(3) All other waters such as intrastate lakes, rivers, streams (including intermittent streams), mudflats, sandflats, and wetlands; the use, degradation or destruction of which could affect interstate commerce including any such waters:

(i) Which are or could be used by interstate travelers for recreational or other purposes; and

(ii) From which fish or shellfish are or could be taken and sold in interstate commerce; and

(iii) Which are used or could be used for industrial purposes by industries in interstate commerce.

(4) All impoundments of waters of the United States otherwise defined as navigable waters under this paragraph.

(5) Tributaries of waters identified in paragraphs (1)–(4) of this section.

(6) Wetlands adjacent to waters identified in paragraphs (1)–(5) of this section, provided that treatment ponds or lagoons designed to meet the requirements of the Clean Water Act (other than cooling ponds meeting the criteria of this paragraph) are not waters of the United States.

Comment: For purposes of clarity, the term "waters of the United States" is used throughout the regulations rather than "navigable waters." In defining the jurisdiction of the FWCA as the "waters of the United States", Congress, as demonstrated in the legislative history to the Act, specified that the term "be given the broadest, consitutional interpretation unecumbered by Agency determinations which would have been made or may be made for administive purposes." While the words of this definition and those of the Corps of Engineers in 33 CFR 323.2(a) for "waters of the United States" differ to comply with intra-agency requirements both definitions describe the same waters.

(t) The term "adjacent" means bordering, contiguous, or neighboring. Wetlands separated from other waters of the United States by man-made dikes or barriers, natural river berms beach dunes and the like are "adjacent wetlands."

(u) The term "impoundment" means a standing body of open water created by artificially blocking or restricting the flow of a river, stream, or tidal area.

(v) The term "dredged material" means material that is excavated or dredged from waters of the United States.

(w) The term "discharge of dredged material" means any addition of dredged material into the waters of the United States. The term includes, without limitation, the addition of dredged material into waters of the United States and the runoff or overflow from a contained land or water disposal area. Discharges of pollutants into waters of the United States resulting from the onshore subsequent processing of dredged material that is extracted for any commerical use (other than fill) are not included within this term and are subject to section 402 of the Clean Water Act even though the extraction and deposit of such material may

require a permit from the Corps of Engineers.

(x) The term "fill material" means any material used for the primary purpose of replacing an aquatic area with dry land *or of changing the bottom elevation of a* waterbody. The term does not include any pollutant discharged into the water primarily to dispose of waste, as that activity is regulated under section 402 of the Clean Water Act Amendments of 1977.

(y) The term "discharge of fill material" means the addition of fill material into waters of the United States. The term generally includes, without limitation, the following activities: Placement of fill that is necessary to the construction of any structure in a water of the United States; the building of any structure or *impoundment requiring rock, sand, dirt,* or other material for its construction; site-development fills for recreational, industrial, commercial, residential, and other uses; causeways or road fills; dams and dikes; artificial islands; property protection and/or reclamation devices such as rip-rap, groins, seawalls, breakwaters, and revetments; beach nourishment; levees; fill for structures such as sewage treatment facilities; intake and outfall pipes associated with power plants and subaqueous utility *lines; and artificial reefs.*

§ 230.4 Organization, use, adaptability of the Guidelines.

(a) *Organization.* The Guidelines are divided into nine subparts. Subpart A presents those provisions of general applicability, such as purpose and definitions. Subpart B establishes the four general conditions which must be *satisfied in order to make a finding that* a proposed discharge of dredged or fill material complies with the Guidelines. Subpart C sets forth factual determinations which are to be considered in determining whether or not a proposed discharge satisfies the Subpart B conditions of compliance. In addition, Subpart C prescribes a number of physical, chemical, and biological evaluations and testing procedures to be *used in reaching the required factual* determinations. Subpart D describes the physical and chemical components of a site and provides guidance as to how proposed discharges of dredged or fill material may affect these components. Subparts E–G detail the special characteristics of particular aquatic and wetland ecosystems in terms of their values, the possible loss of these values due to discharges of dredged or fill material, and the means to prevent these losses from occurring.

Comment: The extent of use of Subparts E–G depends upon whether the resources discussed in these categories are present at the discharge site. For example, if it is determined that no sanctuaries or refuges are sufficiently close to the discharge site to be affected by the discharge, than no further consideration of § 230.4 is necessary. It is unlikely that a large number of the categories in Subparts E–G will be used in any given discharge consideration.

Subpart H recognizes that in certain *circumstances, the discharge of dredged* or fill material can benefit the environment. Subpart I treats General permits and preselection of disposal sites.

(b) *Use.* In evaluating whether a particular discharge site may be specified, the permitting authority should use these Guidelines in the following sequence (see also Flow Chart I):

(1) In order to obtain an overview of the principal regulatory provisions of the Guidelines, review the *conditions of compliance* of § 230.10(b) and (c), the *measures to minimize adverse impact*— or "permit conditions"—of § 230.10(d) and the required *factual determinations* of § 230.20.

(2) Examine *practical alternatives* to discharge into waters of the U.S.—that is, *not* discharging into the waters—or discharging into alternative aquatic site with potentially less damaging consequences (see § 230.10(a)).

(3) Evaluate the material to be discharged to determine the possibility of *chemical (toxic) contamination or physical incompatibility of the material* to be discharged (230.22 and 230.21(b)).

(4) If chemical contamination is reasonably believed to be probable, conduct the appropriate *tests* according to the section on Evaluation and Testing (§ 230.23).

(5) *Identify a candidate disposal site* based upon the criteria and evaluations of § 230.23(f).

(6) *Evaluate the candidate disposal* site with respect to the various *physical and chemical components* which characterize the non-living environment of the site—the substrate and the water including its dynamic characteristics (Subpart D).

(7) At the candidate disposal site, *identify and evaluate any special or critical characteristics* of the site related to its living communities or human uses (Subparts E, F, and G).

(8) Make appropriate and practical changes to the project plan to *minimize the environmental impact* of the discharge, based upon both the specialized Guidelines to Minimize Impacts of each paragraph (c) in Subparts D through G and the general measures to minimize impact in § 230.10(d).

(9) *Make and document Special Determinations* of appropriate paragraphs (d) in Subparts E through G.

(10) *Make and document General Determinations* in § 230.20 based upon the evaluations and tests of Subparts C and D.

(11) *Make and document Findings of Compliance* by comparing the General and Special Determinations with the Conditions of Compliance of § 230.10.

This outline of the steps to follow in using the Guidelines is simplified for purposes of illustration. The permitting authority must address all of the relevant provisions of the Guidelines in reaching a Finding of Compliance in an individual case.

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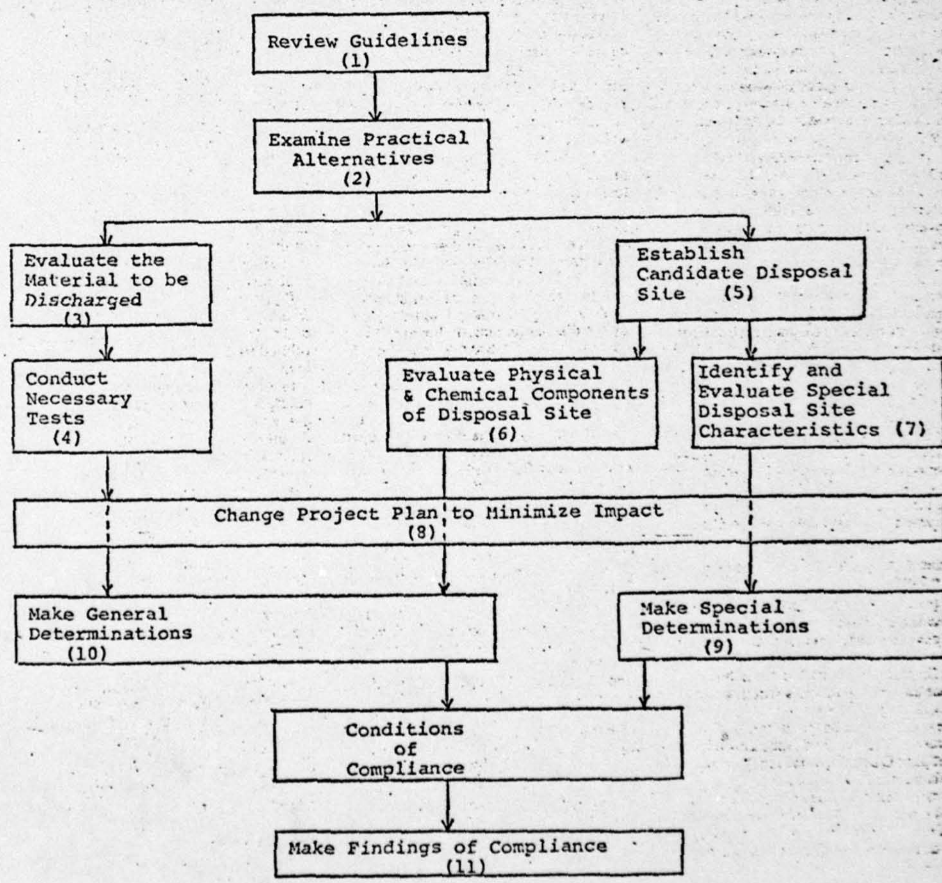
FLOW CHART I



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(c) *Adaptability to particular types of activities.* (1) The manner in which these Guidelines are used depends on the nature of the extraction site, the material to be discharged, and the candidate disposal site, including important environmental components. Documentation to demonstrate knowledge about the extraction site, materials to be extracted, and candidate disposal site is an essential component of guideline application. These Guidelines are broad enough to allow appropriate evaluation and documentation for a variety of activities, ranging from those with the potential for large, complex impacts on the aquatic environment and wetlands, to those for which the impact is likely to be innocuous. However, it is unlikely that the Guidelines will apply in their entirety to any one activity, no matter how complex. It is anticipated that substantial numbers of permit applications will be for minor routine activities that have little, if any, potential for noticeable environmental impacts. Although there may be exceptional cases, and while in certain situations the cumulative impact of a number of such discharges could in fact be significant, it generally is not intended or expected that extensive testing, evaluation or analysis will be needed to make findings of compliance in such routine cases.

The Guidelines user, including the agency or agencies responsible for implementing the Guidelines, must recognize the different levels of effort that should be associated with varying degreds of impact and require or prepare commensurate documentation. The level of documentation should reflect the significance and complexity of the discharge activity.

An essential part of the evaluation process involves making initial and intermediate determinations as to the relevance of any factor or portion(s) of the Guidelines and conducting further evaluation only as needed. However, where portions of the Guidelines review procedure are to be abbreviated, (i.e., "short form" evaluation) there still must be sufficient information including consideration of both individual and cumulative impacts (See § 230.72), to support the decision of whether to specify the site for disposal of dredged or fill material and to support the decision to curtail or abbreviate the evaluation process. The presumption against the discharge in 230.1 applies to this decision making.

Comment: Activities may be stratified with respect to their probable impact on the aquatic ecosystem, including wetlands. Examples of criteria for stratifying such impacts are:

(1) The history of extraction and use of the proposed disposal site; for instance, where discharges from maintenance dredging of a navigation channel have been authorized under Section 404 over a period of years, it may only be necessary to document that the impacts (including cumulative impacts) of future discharges would not differ from past impacts.

(2) The availability of approved areawide plans such as Coastal Zone Management plans and 208 plans which include treatment of disposal sites for the discharge of dredged or fill material. Supplementary documentation may be required for specific activity involving discharges to complement the broad documentation already contained in the plan.

(3) Availability of relevant information in the files of Federal, State, or local authorities. Supplementary documentation may be required to ensure that all applicable aspects of these Guidelines are considered in arriving at the Section 404 permit decision.

(4) Size and complexity of project.

(5) Likelihood of secondary and cumulative impacts.

(6) Similarity to previously reviewed projects.

In the case of activities covered by General Permits, the documentation required by the Guidelines is for General Permit promulgation and not for activities subject to General Permit control. These Guidelines do not require reporting or formal written communication at the time individual activities are initiated under a General Permit. However, a particular General Permit may require appropriate reporting.

Subpart B.—Compliance With the Guidelines

§ 230.10 Conditions of compliance.

Although all conditions of compliance in the § 230.10 must be met, the compliance evaluation procedures will vary to reflect the seriousness of potential for adverse impact on the aquatic ecosystems including wetlands, posed by specific dredged or fill material discharge activities. (§ 230.4(c)).

(a) The discharge of dredged or fill material does not comply with the Guidelines if there is a practicable alternative to the proposed discharge that is environmentally preferable and will have less adverse impact on the aquatic ecosystem (see Flow Chart II).

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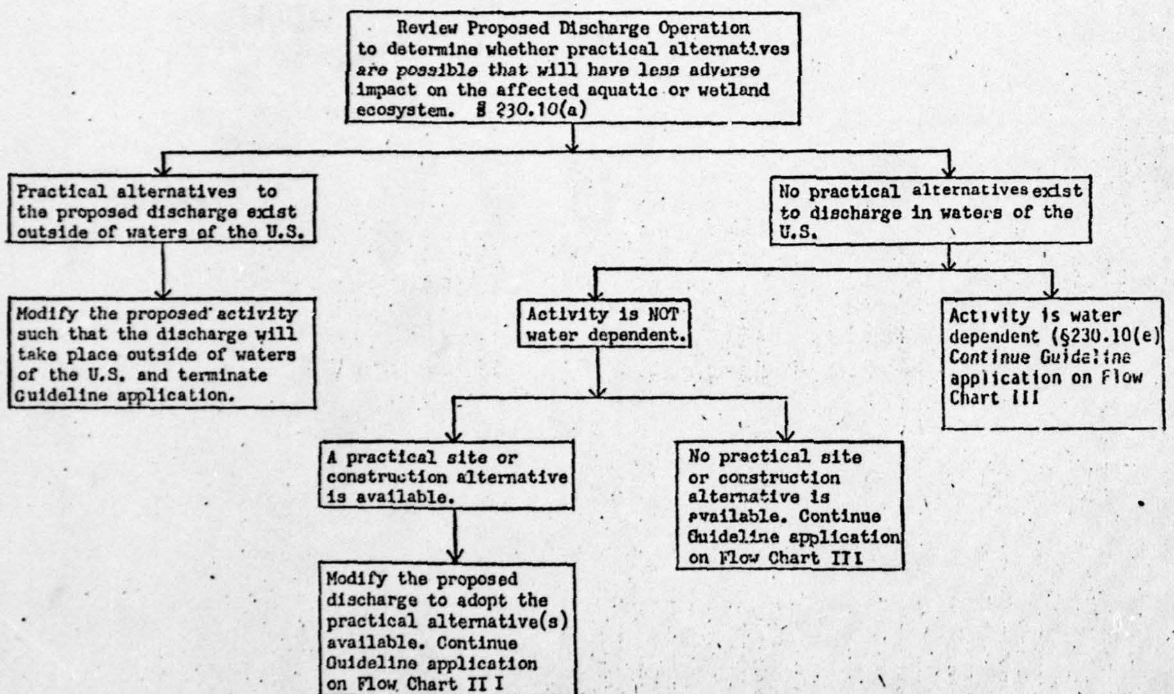
Flow Chart II



(1) For the purpose of making this finding, practicable alternatives include, but are not limited to:

(i) Activities which do not involve a discharge of dredged or fill material into the waters of the United States or ocean waters;

(ii) Discharges of dredged or fill material at other locations in waters of the United States or ocean waters.

Comment: Areas not presently owned by the applicant which could reasonably be obtained, utilized, expanded or managed for project purposes may be considered as practicable alternatives.

(iii) Discharges of other particular volumes and concentrations of pollutants at other specific rates.

(2) In determining whether an alternative is practicable, consideration may be given to economic, technical, and logistical factors.

(3) (i) If all practicable alternatives to a proposed discharge (including the "no action" alternative), have been identified and evaluated through the NEPA process or other planning and evaluation process, further development of the alternatives may not be necessary under this paragraph, provided that the original development of alternatives complies with the requirements identified in this section and elsewhere in the Guidelines. References to such an evaluation shall be made in the written determination of findings, required by § 230.11(b).

(ii) Similarly, if an evaluation of all practicable alternative disposal sites has been conducted in a comprehensive planning process, such as a coastal zone management program or a 208 program, and if this evaluation is comparable in scope to the alternatives evaluation described in this section, it may serve as the basis for that part of the alternatives finding described in paragraph (a) above. However, because such a planning process may not be project-specific, it may be necessary to supplement the alternatives findings in paragraphs (g) (3) (i) and (3)(ii) through consideration of additional detailed information at the time a particular discharge is proposed or when further review of a class or category of activities is undertaken (General Permits or Best Management Practices).

Comment: When Federal planners and permit evaluators and state regulatory agencies conduct alternative studies under other authorities, they should consider the requirements of the Guidelines to ensure the usefulness of such studies for regulatory purposes under section 404.

(b) The discharge of dredged or fill material does not comply with the Guidelines if the discharge will:

(1) After consideration of dilution and dispersion at the disposal site, cause or contribute to ambient water quality which violates any applicable State water quality standard, approved or promulgated by EPA under section 303 of the Act, or any applicable water quality criteria promulgated by EPA;

(2) Violate any applicable toxic effluent standards or prohibitions under section 307 of the Act;

(3) Result in the introduction outside the disposal site of toxic substances in amounts which cause destruction of organisms through acute or chronic toxicity or through physiological disturbance or which will result in potential adverse effects in a consumer organism through bioaccumulation of the substance in the aquatic organism;

(4) Jeopardize the continued existence of an endangered or threatened species or result in the destruction or adverse modification of a habitat which is determined by the Secretaries of Interior or Commerce, as appropriate, to be a critical habitat under the Endangered Species Act of 1973 unless an exemption has been granted by the Endangered Species Committee;

Comment: The reference to the Endangered Species Committee is included in recognition of the possibility of exemption from the prohibition of the Endangered Species Act. However, such an exemption is not available where there are other grounds for denying a permit. Therefore, the permitting authority should complete review of the discharge under these Guidelines even where the discharge will not comply with (4).

(5) Disrupt conditions and terms of marine sanctuaries designated by the Secretary of Commerce under Title III of the Marine Protection, Research, and Sanctuaries Act of 1972.

(c) The discharge of dredged or fill material does not comply with these Guidelines if it is determined, after a consideration of § 230.26 where appropriate, that the discharge will have an unacceptable adverse impact on the waters of the United States. The finding of unacceptable adverse impact shall, as a minimum, be based upon appropriate determinations, evaluations, and tests required by Subpart C and any special determinations required by Subparts D through G with special emphasis on the persistence and permanence of such impacts.

(1) It shall be an objective of these Guidelines that the following adverse effects, individually or collectively, be prevented:

(i) Significantly adverse effects of discharge of pollutants on human health or welfare, including but not limited to effects on plankton, fish, shellfish, wildlife, and special areas such as shorelines, beaches, wetlands.

Comment: Fish and wildlife sanctuaries and refuges, parks, national and historical monuments, national seashores, wilderness areas, research sites or similar preserves are examples of other critical areas that should be protected;

(ii) Significantly adverse effects of discharge of pollutants on aquatic life and other wildlife, dependent on aquatic ecosystems, including the transfer, concentration, and dispersal of pollutants or their byproducts through biological, physical, and chemical processes.

(iii) Significantly adverse effects of discharge of pollutants on aquatic ecosystem diversity, productivity, and stability. Such effects may include, but are not limited to, loss of fish and wildlife habitat or loss of the capacity of a wetland to assimilate nutrients or reduce wave energy.

(iv) Significantly adverse effects of discharge of pollutants on aesthetic, recreation, and economic values.

(2) It shall be the additional objective of these Guidelines to prevent the chemical, physical or biological degradation of waters of the U.S. by the discharge of dredged or fill material through management of the number, location, size, and configuration of disposal sites as well as the rate, volume, and concentrations of pollutants in the material discharged. Chemical or physical alteration of a body of water or wetland should be avoided or minimized where possible. Use of waters of the U.S. for discharge of dredged of fill material is presumed to unacceptable unless it can be demonstrated that such a discharge is necessary and will not have an unacceptable adverse impact on the aquatic ecosystem including wetlands, either individually or cumulatively. Where a previously degraded aquatic ecosystem is involved, consideration should be given to the use of dredged or fill material to improve or restore the ecosystem.

Comment: It is the intent of these Guidelines to control and if necessary limit or prohibit discharges of dredged or fill material into the aquatic environment including wetlands. It is of primary importance that movement of material from one place to another not degrade the chemical and physical characteristics of the substrate. Chemical degradation is not likely to occur if the concentration of available chemical components of the material to be discharged is equal to or less than those of the same components at the

disposal site. Degradation can occur as a result of changing characteristics of the aquatic ecosystem, such as altering water level or circulation patterns and littering the environment with piles of discharged material. Restoration of degraded aquatic areas by discharge of dredged or fill material may provide not only disposal sites but also environmental benefits. However, improvements (such as creation of new wetlands) of undisturbed natural areas should be embarked upon only after extensive and careful evaluation of impacts and benefits.

(d) The discharge of dredged or fill material does not comply with these Guidelines if the manner of discharge fails to sufficiently minimize where practicable any potential adverse impact to the aquatic ecosystem including wetlands.

Comment: Discharge technology should be adapted to the needs of each site. In determining whether the discharge operation sufficiently minimizes adverse environmental impacts, the applicant should consider for example:

(1) The type of equipment or machinery, including protective devices, used in activities ancillary to the discharge of dredged or fill material;

(2) The operation and maintenance of such equipment or machinery including adequate operation, staffing, and training;

(3) The method of transportation of the material for discharge;

(4) Limitations on the solid, liquid, and gaseous components of material to be discharged;

(5) The addition of treatment substances such as oxygen to material to be discharged;

(6) Limitations on the amount of material to be discharged per unit of time or volume of receiving water;

(7) The timing of the discharge to minimize impact (e.g., to avoid spawing or migration seasons and periods of undesirable wave, wind, and tidal action);

(8) Proper maintenance and containment of material discharged to prevent erosion, leaching, slumping and other nonpoint sources of pollution;

(9) The method of dispersion of the material;

(10) The location of actual release of material with respect to the substrate and other factors;

(11) The location of the disposal outside of the vicinity of a public water supply intake;

(12) Delay in extraction or exposure of dredged material to different levels of oxygen, pH, temperature, or other particular conditions that will reduce the potency of non-persistent pollutants;

(13) Other measures identified in Subpart D through G of these Guidelines.

(e) In the case of a discharge of fill material into special aquatic or wetland areas (Subpart E), where the activity associated with the fill does not require direct access or proximity to or siting within, the water resource in question to fulfill its basic purpose, the discharge may be allowed only if, in addition to the other requirements of these Guidelines (alternatives, impacts, mitigation), there is a showing that the activity associated with the fill is necessary.

Comment: This subsection requires that an additional test be met by a "non-water dependent" activity before it can be located in a wetland or special aquatic area. This test is intended to prevent the destruction or adverse alteration of wetlands and special aquatic areas by non-water dependent activities except in cases where the applicant can show that the basic purpose of the activity is one for which the local community has a demonstrable need. In assessing the basic purpose of an activity, one must look at the basic service or product it provides. For example, the basic purpose of a housing development located in a wetland site to provide homesite waterfront dockage is still housing. Thus, to meet this test, the applicant would have to show a need for housing, *per se*, not merely a demand for *waterfront* housing.

§ 230.11 Findings of compliance.

(a) On the basis of these Guidelines the proposed disposal sites for the discharge of dredged or fill material must be:

(1) Specified as complying with these Guidelines; or

(2) Specified as complying with these Guidelines with the inclusion of appropriate discharge conditions to minimize pollution or adverse impacts to the affected aquatic ecosystems including wetlands; or

(3) Specified as failing to comply with the requirements of these Guidelines where: (i) There are practicable alternatives to the proposed discharge that will have a less adverse impact on the aquatic ecosystem (§ 230.10(a)) and are environmentally preferable; or (ii) the proposed discharge will result in unacceptable pollution to the aquatic ecosystem (§ 230.10 (b) and (c)); or (iii) the proposed discharge does not include all practicable measures to minimize potential harm to the aquatic ecosystem (§ 230.10(d)); or (iv) there does not exist sufficient information to make a reasonable judgment as to whether the proposed discharge will comply with these Guidelines.

(b) Findings under this section shall be set forth in writing by the District Engineer or, where appropriate, the Director (i.e., the chief administrative officer of a State agency administering a permit program approved by EPA under § 404(g) and § 404(h)) or his delegated representative, for each proposed discharge. These findings shall include the factual determinations required by § 230.20, findings under § 230.10, and a brief explanation of any adaptation of these Guidelines to the activity under consideration. In the case of a General Permit, such findings shall be prepared for that permit rather than for each subsequent discharge under the authority of that permit.

Subpart C—General Physical, Chemical, and Biological Evaluations, Tests, and Determinations

§ 230.20 Factual determinations.

Evaluation and testing procedures described in this subpart shall be applied as required to all proposed discharges of dredged or fill material in order to determine their potential short term or long term effect on the physical and chemical components of the aquatic environment, including wetlands, as described in Subpart D. These determinations, as well as any special factual determinations required by Subparts E through G, must be documented, must describe the scope, methods, and results of examinations used to reach them, and must be considered in making all findings of compliance required by § 230.11. Factual determinations required for each proposed discharge include the following:

(a) *Physical substrate determinations.* A determination shall be made of the nature and degree of effect that the proposed discharge will have on the characteristics of the substrate at the proposed disposal site. Consideration shall be given to the similarity in particle size, shape and degree of compaction of the material proposed for discharge and the material constituting the substrate at the disposal site, and any potential changes in substrate elevation and bottom contours (including changes outside of the disposal site which may occur as a result of erosion, slumpage, or other movement of the discharged material). The environmental characteristics and values, their potential loss, and the Guidelines to minimize impact, as detailed in § 230.30, shall additionally be considered in making these

determinations. Potential changes in substrate elevation and bottom contours shall be predicted on the basis of the proposed method, volume, location, and rate of discharge, as well as on the individual and combined effects of current patterns, water circulation, wind and wave action, and other physical factors that may affect the movement of the discharged material.

(b) *Water circulation, fluctuation, and salinity determinations.* A determination shall be made of the nature and degree of effect that the proposed discharge will have on current patterns, water circulation including downstream flows, normal water fluctuation, and salinity. Consideration shall be given to the potential diversion or obstruction of flow, alterations of bottom contours, or other changes in the hydrologic regime. Additional consideration of the environmental characteristics and values, their possible loss, and the Guidelines to minimize impacts, as detailed in § 230.33–230.35, shall be used in making these determinations. Potential effects on the current patterns, water circulation, normal water fluctuation and salinity shall be evaluated on the basis of the proposed method, volume, location, and rate of discharge.

(c) *Suspended particulates determinations.* A determination shall be made of the nature and degree of effect that the proposed discharge will have in terms of potential changes in the kinds and concentrations of suspended particulates in the vicinity. Consideration shall be given to the grain size of the material proposed for discharge, the shape and size of the plume of suspended particulates, and whether or not the potential changes in the kinds and concentrations of suspended particulates (suspended solids) will cause violations of applicable water quality standards. In making this determination, consideration should also be given to the environmental characteristics and values, to their possible loss, and to the Guidelines for minimizing impact in § 230.31 (Suspended Particulates). Consideration shall include the proposed method, volume, location, and rate of discharge, as well as the individual and combined effects of current patterns, water circulation and fluctuations, wind and wave action, and other physical factors on the movement of suspended particulates. Suspended particulate bioassay testing, as described in § 230.23, may be required to determine the impact of increased suspended particulate levels on filter-feeding and other vulnerable aquatic organisms.

(d) *Wetland and other aquatic biota determinations.* A determination shall be made of the nature and degree of effect that the proposed discharge will have (both individually and cumulatively) on the structure, function and habitat of wetland and other aquatic biota. Consideration shall be given to potential changes in substrate characteristics and elevation, water or substrate chemistry, and water currents, circulation, fluctuation, or salinity that would significantly affect the recolonization of the proposed disposal site by indigenous fish, wildlife, and aquatic communities. The environmental characteristics and values, their possible loss, and the Guidelines to minimize impacts, as detailed in §§ 230.30–230.35, and the appropriate section of Subparts D–F shall additionally be considered in making these determinations. Biological tests including inventories, bioassays, and bioaccumulation tests as described in § 230.23 may be required to provide information on both the physical and chemical suitability of the discharge material to support the communities or populations of organisms existing at the proposed disposal site.

(e) *Toxic pollutant determinations.* A determination shall be made of the degree to which the material proposed for discharge will introduce, relocate, or increase the amount of toxic pollutants listed under section 307(a)(1) of the Act. This determination shall consider the solid, liquid and/or suspended particulate phase of the material discharged, and the aquatic environment at the proposed disposal site. Such pollutants are presumed to be present unless demonstrated otherwise by the procedure outlined in § 230.22, or the tests outlined in § 230.23.

Comment: Under section 307(a)(1) of the Act, the Administrator must establish a list of toxic pollutants. Effluent guidelines will be developed for industries discharging listed substances and effluent standards will be established as appropriate. In addition, under section 307(a)(5) of the Act, the Administrator, after consultation with the Secretary of the Army, may designate dredged material as a category subject to effluent standards or prohibitions established under § 307(a)(2). Notwithstanding the current absence of effluent limitations for toxic substances in dredged material, substances listed under section 307(a) of the Act are a primary concern in the evaluation of the effects of proposed discharges of dredged or fill material under section 404 of the Act.

(f) *Biological availability determinations.* A determination shall be made of the potential for acute or chronic effects on aquatic organisms, including bioaccumulation, as a result of the biological availability of pollutants in the solid, liquid, or suspended particulate phases. Such effects will be presumed to occur where toxic pollutants listed under section 307(a)(1) of the Act have not been demonstrated to be absent by the procedure outlined in § 230.22 or by the tests outlined in § 230.23.

(g) *Proposed disposal site appearance determinations.* A determination shall be made of the appearance of the proposed disposal site and appropriate parts of the surrounding environment prior to the initiation of a discharge activity. Photographic determinations are preferable to narrative descriptions, provided they are accompanied by pertinent data such as exact location of photographer and direction of exposure, time of year and day and weather conditions affecting film exposure, the kind of camera, lens, etc. used, and the photograph clearly depicts those aspects of the aquatic environment and wetlands that will be impacted or modified by the discharge activity.

Comment: The appearance of the proposed disposal site and its surroundings prior to any discharge activity is relevant to the findings required in §§ 230.10 and 230.11. Sufficiently detailed information concerning the appearance of the disposal site before discharge occurs will aid in predicting the impact of the discharge, assessing the adequacy of measures to minimize impacts, monitoring compliance with the permit, and restoring the site where appropriate.

(h) *Special determinations.* A determination shall be made of whether the material to be discharged will disrupt any special disposal site characteristics, taking into consideration the resource values, possible loss of these resources, and these Guidelines, as well as special determinations described in Subparts E through G of the proposed disposal site.

§ 230.21 Purpose and use of evaluation and testing.

(a) The purpose of the evaluation procedure in § 230.22 and the chemical and biological testing sequence outlined in § 230.23 is to provide information to reach the determinations required by § 230.20. Where the results of prior evaluations, chemical and biological tests, scientific research, and experience can provide information helpful in reaching a determination, these should be used. Such prior results may make

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new testing unnecessary. The information used to reach each determination shall be documented, except that where the same information is applicable to more than one determination, it may be documented in one instance and referenced in later determinations.

(b) To reach the determinations related to the potential effects of the discharge on physical characteristics of the disposal site (i.e., determinations on physical substrate characteristics, water circulation, fluctuation, salinity, and suspended particulates), the narrative guidance provided in Subpart D may be applied along with appropriate physical tests and evaluations.

Comment: Such tests may include sieve tests, settleability tests, and compaction tests, dilution and dispersion zone and suspended particulate plume determinations, and site assessments of water flow, circulation, and salinity characteristics.

(c) To reach the determinations involving potential effects of the discharge on the chemical characteristics of the disposal site (i.e., determinations on suspended particulates, aquatic and wetland organisms and vegetation, toxic pollutants, biological availability, and water quality standards), the narrative guidance in Subparts D–F shall be used along with the general evaluation procedure in §230.22, and the chemical and biological testing sequence in § 230.22, and the chemical and biological testing sequence in § 230.23 and prediction of dilution and dispersion in § 230.23(e) to examine the solid, liquid, and suspended particulate phases of the dredged or fill material proposed for discharge.

(d) The general evaluation procedure described in § 230.22 can be used to eliminate the need for further chemical and biological testing to determine the presence or absence of toxic pollutants in proposed discharges of dredged or fill material, where the material can be shown to be sufficiently removed from surces of pollution. Where the results of the evaluation do not provide the necessary information to reach the required determinations in § 230.20(c)–(g), the chemical and biological testing sequence outlined in § 230.23 and prediction of dilution and dispersion in § 230.23(e) for the solid, liquid, and suspended particulate phases shall be followed.

(e) In applying the chemical and biological evaluations and tests required by these Guidelines, the differences between dredged material (including dredged material used as fill) and fill material must be considered.

(f) In addition to the evaluation and chemical and biological testing procedures in Subpart C and the narrative guidance on the physical and chemical components of the aquatic wetland environment in Subpart D, the information provided in Subparts E–G (describing resource values, possible loss of resources, and guidelines to protect special characteristics of the aquatic and wetland environment) must be examined to reach the special determinations required by § 230.20(i).

§ 230.22 General evaluation of dredged or fill material.

(a) If dredged or fill material is evaluated under § 230.22(b) and determined not to be a carrier of contaminants, then the determinations required in § 230.20 can be made without testing under § 230.23.

Comments: Under § 230.20(e), toxic pollutants on the 307(a)(1) list are presumed to be present unless eliminated from consideration by the § 230.22(b) evaluation or further testing under § 230.23. Other contaminants must be tested under § 230.23 if the evaluation under § 230.22(b) or other information suggests that they may be present. The purpose of the tests in § 230.23 is to demonstrate the probable impact of a discharge of the material on the aquatic community, human uses of the environment, and any other aspect of the ecosystem susceptible to degradation.

Adaptation of the evaluation and testing process in these Guidelines by permitting authorities under § 230.4 may lead to presentation of different testing protocols. However, such protocols cannot be used to change the intent or requirements of these Guidelines.

(b) The extraction site shall be examined in order to assess whether it is sufficiently removed from sources of pollution to provide reasonable assurance that the proposed discharge material is not a carrier of contaminants. Factors to be considered in demonstrating reasonable assurance of the absence of such pollution include but are not limited to:

(1) Potential routes of pollution or polluted sediments to the extraction site, based on hydrographic or other maps, aerial photography, or other graphic methods that show watercourses, surface relief, proximity to tidal movement, private and public roads, location of buildings, municipal and industrial areas, and agricultural or forest lands;

(2) Pertinent results from tests previously carried out on the material at the extraction site, or carried out on similar material for other permitted projects in the vicinity (such results may be available as public information in the files of government agencies, universities, and elsewhere). The results of tests carried out on material similar to the material proposed for discharge may be relevant. Materials shall be considered similar if the sources of contamination, the physical configuration of the sites and the sediment composition of the materials are comparable, in light of water circulation and stratification, sediment accumulation and general sediment characteristics. Tests from other sites may be relied on only if no changes have occurred at the extraction sites to render the results irrelevant.

(3) Any potential for significant introduction of pesticides from land runoff;

(4) Any records of spills of petroleum products or substances designated as hazardous under Section 311 of the Clean Water Act (see 40 CFR 116–119);

(5) Information in Federal, State and local records indicating significant introduction of pollutants from industries, including types and amounts of waste materials discharged along the potential routes of contaminants to the extraction site; and

(6) Any possibility of the presence of substantial natural deposits of minerals or other substances which could be released to the aquatic environment or wetlands by man-induced discharge activities.

Comment: Dredged or fill material is most likely to be free from chemical, biological, radiological or other pollutants where it is composed primarily of sand, gravel, or other naturally occurring inert material with particle sizes larger than silt (63 microns or one-sixteenth of a millimeter). Dredged material so composed is generally found in areas of high current or wave energy such as streams with large bed loads or coastal areas with shifting bars and channels. However, when such material is discolored or contains other indications that polluted materials may be present, further inquiry should be made.

(c) Where the discharge site is adjacent to the extraction site and subject to the same sources of pollution, and materials at the two sites are substantially similar, the fact that the material to be discharged technically may be a carrier of pollution is not likely to result in degradation of the substrate at the disposal site upon its discharge. In such circumstances, when dissolved material and suspended particulates can be controlled to prevent carrying pollutants to uncontaminated areas,

testing under § 230.23 may not be required.

(d) Where the § 230.22(b) evaluation leads to the conclusion that there is a high probability that the material proposed for discharge is a carrier of pollutants, testing may not be necessary if constraints are available to reduce conditions to acceptable levels within the disposal site and to prevent contaminants from being transported beyond the boundaries of the disposal site, if such constraints are acceptable to the permitting authority, and if the potential discharger accepts and has the capability to implement such constraints.

Comment: An example of such a constraint might be a properly designed and operated contained disposal site.

(e) The presumption that toxic pollutants on the 307(a)(1) toxics list are present in sediments may be accepted following application of the examination specified in § 230.22(b) without conducting a sediment chemical analysis. However, acceptance of such a presumption does not preclude the requirement to supply information about the probable impact of discharge of sediment so contaminated on receiving aquatic ecosystems, including wetlands.

Comment: If a severely polluted sediment condition is established during this General Evaluation (§ 230.22) which will lead to requirement of bioassays, and a sufficiently large number of chemicals are present to render impractical the identification of all chemical pollutants by testing, chemical testing information reasonably may be obtained from bioassays. Severely polluted sediment conditions can be established during this General Evaluation (§ 230.22) by: previous tests (although the results of such tests may not be adequate for other uses in these Guidelines), the presence of polluting industries and information about their discharge or runoff into waters of the U.S., bioinventories, etc.

(f) The information justifying any decision not to test must be documented in § 230.20 Factual Determinations for use in § 230.11 Findings of Compliance.

§ 230.23 Evaluation and testing.

(a) No single test or approach can be applied in all cases to evaluate the effects of proposed discharges of dredged or fill materials. The chemical changes in water quality may best be simulated by use of an elutriate test. To the extent permitted by the state of the art, expected effects such as toxicity, stimulation, inhibition or bioaccumulation may best be estimated by appropriate bioassays. In determining which tests and/or evaluation procedures are necessary in a given case, the permitting authority shall refer to §230.4(c), Adaptability to Particular Types of Activities. EPA in conjunction with the Corps of Engineers will publish a procedures manual that will cover summary and description of tests, definitions, sample collection and preservation, procedures, calculations, and references. Interim guidance to applicants concerning the applicability of specific approaches or procedures will be furnished by the District Engineer.

(b) *Chemical-biological interactive effects.* Ecological perturbation caused by chemical-biological interactive effects resulting from discharges of dredged or fill material is very difficult to predict. Research performed to date has not clearly demonstrated the extent of chemical-biological interactive effects resulting from contaminants present in the dredged or fill material. The principal concerns of open water discharge of dredged or fill material that contain chemical contaminants are the potential effects on the water column or on benthic communities.

(1) *Evaluation of chemical-biological interactive effects.* Dredged or fill material may be excluded from the evaluation procedures specified in paragraphs (b)(2) and (3) of this section if it is determined on the basis of the evaluation in § 230.22 that the likelihood of contamination by toxic pollutants is acceptably low, unless the District Engineer, after evaluating and considering any comments received from the Regional Administrator, determines that these approaches and procedures are necessary. The Regional Administrator may require, on a case-by-case basis, testing approaches and procedures by stating what additional information is needed through further analyses and how the results of the analysis will be of value in evaluating potential environmental effects.

(2) *Water column effects.* Sediments normally contain constituents that exist in different chemical forms and are found in various concentrations in several locations within the sediment. The potentially bioavailable fraction of a sediment is dissolved in the sediment interstitial water or in a loosely bound form that is present in the sediment. In order to predict the effect on water quality due to release of contaminants from the sediment to the water column, an elutriate test may be used. The elutriate is the supernatant resulting from the vigorous 30-minute shaking of one part bottom sediment from the dredging site with four parts water (vol./vol.) collected from the dredging site followed by one-hour settling time and appropriate centrifugation and a 0.45μ filtration. Major constituents to be analyzed in the elutriate are those deemed critical by the District Engineer, after evaluating and considering any comments received from the Regional Administrator, and considering results of the evaluation in § 230.22. Elutriate concentrations observed should be evaluated with regard to with the same constituents in disposal site water and other data which describe the Volume and rate of the intended discharge, the type of discharge, the hydrodynamic regime at the disposal site, and other available information that aids in the evaluation of impact on water quality (including bioaccumulation tests). The District Engineer may specify bioassays when he determines that such procedures will be of value. In reaching this determination, dilution and dispersion effects subsequent to the discharge at the disposal site will be considered.

(3) Suspended particulate effects. Suspended particulate phase bioassay testing shall be required to make the determination in § 230.20(c), (e) and (f) where such determinations cannot be made based upon the general evaluation in § 230.22 or any other previously run currently valid tests. The suspended particulate bioassay may be necessary to determine the effect of uncontaminated suspended particulates on filter-feeding organisms or other vulnerable aquatic species, as well as to determine the bioavailability of toxics in the suspended particulate phase. Where suspended particulate testing of dredged material is required, (suspended particulate phase procedures do not apply to fill material), a bioassay test shall be conducted.

(4) *Effects on benthos.* Evaluation of the significance of chemical-biological interactive effects on benthic organisms resulting from the discharge of dredged or fill material is extremely complex and demands procedures which are at the forefront of the current state of the art. Although research has shown that benthic species can ingest contaminated sediment particles, it has not been determined to what degree the contaminants are dissociated from the sediment and incorporated into benthic body tissues thereby gaining entry to the food web. The District Engineer may use an appropriate benthic bioassay (including bioaccumulation tests) when such procedures will be of value in assessing ecological effect and in establishing discharge conditions.

(c) *Procedure for comparison of sites.* (1) When an inventory of the total

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concentration of chemical constituents deemed critical by the District Engineer would be of value in comparing sediment at the dredging site with sediment at the disposal site, he may require a sediment chemical analysis. Markedly different concentrations of critical constituents between the excavation and disposal sites may aid in making an environmental assessment of the proposed disposal operation. Such analyses should be interpreted in terms of the potential for harm as supported by any pertinent scientific literature or as interpreted in criteria such as the Quality Criteria for Water.

(2) When an analysis of biological community structure will be of value to assess the potential for adverse environmental impact at the proposed disposal site, a comparison of the biological characteristics between the excavation and disposal sites may be required by the District Engineer. Biological indicator species may be useful in evaluating the existing degree of stress at both sites. Sensitive species representing community components colonizing various substrate types within the sites should be identified as possible bioassay organisms if tests for toxicity are required. Community structure studies are expensive and time consuming, and therefore should be performed only when they will be of value in determining discharge conditions. This is particularly applicable to large quantities of dredged material known to contain adverse quantities of toxic materials. Community studies should include benthic organisms such as microbiota and harvestable shellfish and finfish. Abundance, diversity, and distribution should be documented and correlated with substrate type and other appropriate physical and chemical environmental characteristics.

(d) *Size of disposal site.* The specified disposal site shall be confined to the smallest practicable area consistent with the type of dispersion determined to be appropriate by the application of these guidelines. In a few special cases under unique environmental conditions, the discharged material may be intended to be spread naturally in a very thin layer over a large area of the substrate rather than be contained within the disposal site. Where there is adequate justification to show that wide-spread dispersion by natural means will result in no significantly adverse environmental effects the discharge is not subject to the normal constraints on size of disposal site in this paragraph. Although the impact of the particular discharge may constitute a minor change, the cumulative effect of numerous such piecemeal changes often results in a major impairment of the water resources and interferes with the productivity and water quality processes of existing environmental systems. Thus, the particular disposal site will be evaluated with the recognition that it is part of a complete and interrelated ecosystem. The District Engineer may undertake reviews of particular areas in response to new applications, and in consultation with the appropriate Regional Director of the Fish and Wildlife Service, the Regional Director of the National Marine Fisheries Service of the National Oceanic and Atmospheric Administration, the Regional Administrator of the Environmental Protection Agency, the State Conservationist of the Soil Conservation Service of the Department of Agriculture, and the head of the appropriate State agencies, including the State Director of an approved Coastal Zone Management Program, to assess the cumulative effect of activities in such areas.

(e) *Fill material testing procedures.* Fill material means any pollutant including dredged materials, used to create fill in the traditional sense of replacing an aquatic or wetland area with dry land or changing the bottom elevation of a water body for any purpose. In order to serve that function, fill material must remain in place and generally be capable of bearing weight. This often requires confinement of fill material, which raises the possibility of percolation through or run-off or displacement of the fill by cataclysmic events of nature.

There is little or no sorting of material in a fill. Fill material originating on land may be inert as is the case of granite blocks used for rip rap, or it may consist of soil which could be clean or be contaminated from nearby pollution sources or by waste discharges. If the evaluation under § 230.22 indicates the need for testing, the procedures below should be followed.

(1) *Water Leachate Test.* Where toxic pollutants have not been eliminated through the procedures in § 230.22, water leachate tests for fill material may be conducted to make the determinations required by section 230.20.

(2) *Biological tests.* Biological tests of fill material proposed for discharge, adapted from those described in § 230.23, may be used to determine the acute or chronic effects of polluted fill material upon aquatic and wetland organisms.

(f) *Mixing zone determination.* The dilution and dispersion zone shall be the smallest practicable zone within each specified disposal site, consistent with the objectives of these guidelines, in which desired concentrations of constituents must be achieved.

The District Engineer and the Regional Administrator shall consider the following factors in determining the acceptability of a proposed dilution and dispersion zone:

(i) Depth of water at the disposal site;
(ii) Current velocity, direction, and variability at the disposal site;
(iii) Degree of turbulence;
(iv) Stratification attributable to causes such as obstructions, salinity or density profiles at the disposal sites;
(v) Discharge vessel speed and direction, if appropriate;
(vi) Rate of discharge;
(vii) Ambient concentration of constituents of interest;
(viii) Dredged material characteristics, particularly concentrations of constitutents, amount of material, types of material (sand, silt, clay, etc.) and settling velocities;
(ix) Number of discharge actions per unit of time;
(x) Other factors of the disposal site that affect the rates and patterns of mixing.

Subpart D—Physical and Chemical Components of the Aquatic Ecosystem, Including Wetlands

§ 230.30 Substrate.

The substrate is the solid phase of the aquatic ecosystem, including wetlands, underlying open and adjacent waters of the U.S. and constituting the surface of wetlands. It consists of organic and inorganic solid materials and includes water and other liquids or gases that fill the spaces between solid particles.

(a) *Environmental characteristics and values.* Natural substrates furnish habitat for aquatic plants and animals. These plants and animals often exhibit a variety of structural and behavioral specializations that adapt them to specific types of substrate environments. Substrates vary with respect to particle size and shape, chemical composition, and degree of compaction. The elevation and contours of substrates, molded in part by activity of overlying water, exert a pronounced underwater damming and directional influence on the manner in which water circulates. The chemical processes carried on in the substrate include the absorption and adsorption of materials introduced into the aquatic ecosystem, the production and exchange of gaseous substances, and decomposition and

cycling of inorganic and organic matter by the action of microbes and chemical processes. New material can accumulate naturally on substrates from the water column in the form of settling suspended particulates.

(b)(1) *Possible loss of environmental characteristics and values.* The discharge of dredged or fill material can result in varying degrees of change in the complex physical, chemical, and biological characteristics of the substrate. These changes can adversely affect the substrate environment and are often reflected throughout the entire aquatic ecosystem. The discharge of sufficient amounts of dredged or fill material to alter substrate elevation or contours can result in water circulation, current pattern, water fluctuation and water temperature changes. Erosion or slumpage of such deposits can adversely affect areas of the substrate outside the perimeters of the disposal site by changing or destroying habitat. Bottom-dwelling organisms at the site might be smothered or forced to migrate as a result of a discharge, but similar forms may recolonize on the discharged material. However, when discharged material is very dissimilar from that of the discharge site, recolonization by similar organisms at the site is unlikely. Adverse changes in the substrate can result from the bulk, composition, location, method, and timing of discharges.

(2) Adverse impacts can be compounded by the presence of contaminants in the dredged or fill material. Such effects may be immediate or long-term, localized or broadly dispersed through the aquatic ecosystem. Generally sediments extracted from heavily industrialized or settled areas can be expected to be contaminated with materials known to be discharged in the waters of such an area. The impact of contaminants contained in dredged and fill material is dependent upon the interaction among a wide range of poorly understood variables that affect their release into the immediate aquatic ecosystem.

(c) *Guidelines to minimize impacts.* In addition to the consideration of alternatives in § 230.10(a), the Guidelines to minimize impacts as described in § 230.10(d), and water dependency in § 230.10(e), specific measures to minimize impacts on the substrate include, but are not limited to:

(1) Confining the discharge to the smallest practicable deposition zone where mounding of material on the substrate at the disposal site will protect the characteristics and values of the surrounding substrate.

(2) Spreading or scattering discharge material where maximizing the size of the deposition zone will minimize the thickness of the layer of material or the substrate and prevent loss of characteristics and values attributable to mounding.

(3) Selecting discharge methods and disposal sites where the potential for erosion, slumping or leaching of materials into the surrounding aquatic ecosystem will be reduced. These methods or sites include, but are not limited to:

(i) Using containment levees, sediment basins, and cover crops to reduce erosion;

(ii) Using lined containment areas to reduce leaching where leaching of chemical constituents from the discharged material is expected to be a problem; and

(iii) Using contained areas and avoiding discharges near steep slopes of channels in unsuitable areas to reduce slumpage.

(4) Selecting a disposal site that has been used previously for dredged material discharge.

(5) Selecting an upland disposal site where available and where determined to be an environmentally satisfactory alternative (See § 230.10(a)).

(6) Selecting a disposal site at which the substrate is composed of material similar to that being discharged such as discharging sand on sand or mud on mud.

(7) Discharging material at a location and by methods which minimize changes in substrate elevation, thereby preventing modification of water mass movement leading to erosion or other adverse impacts.

(8) Considering the use of habitat development or restoration measures, where appropriate.

(9) Discharging at times of the year which will minimize adverse effects on the aquatic ecosystem.

(10) Capping in-place contaminated material with clean material or selectively discharging the most contaminated material first so it can be capped with the remaining material as appropriate.

§ 230.31 Suspended particulates.

Suspended particulates in the aquatic ecosystem, including wetlands, consist of fine-grained mineral particles usually smaller than silt, and organic particles. Suspended particulates may enter water bodies as a result of runoff from land, flooding uplands, flushing wetlands, debris from planktonic organisms and higher vegetation, resuspension of bottom sediments, and man's activities. Particulates may remain suspended in the water column for variable periods of time as a result of such factors as agitation of the water mass, particulate specific gravity, particle shape, and physical and chemical properties of particle surfaces.

(a) *Environmental characteristics and values.* Suspended particulates nourish plants by releasing nutrients in both inorganic and organic form to the water column. Suspended organic particles supply food for detritus feeding organisms. Suspended particulates also absorb and adsorb chemicals including pollutants from the water column, adding such materials to the substrate as they settle to the bottom. Suspended particulates settle and reconstitute the substrate when water currents or velocities decrease. Thus, they are present in the water column in greatest amounts at times of high flow or high water levels, but usually for relatively short periods. Large streams, carrying huge sediment loads like the Mississippi River, contain large amounts of suspended particulates much of the time. Other water bodies, like some springs and creeks in stable watersheds of well-forested mountains, only occasionally bear large amounts of suspended particulates. Organisms inhabiting both extremes exhibit marked specializations which adapt them for the environment in which they are found.

(b) *Possible loss of enviromental characteristics and values.* The discharge of dredged or fill material can result in greatly elevated levels of suspended particulates in the water column. High turbidity reduces light penetration which lowers the rate of photosynthesis and the primary productivity of an aquatic area. Sight-dependent species are impacted through reduced feeding ability, leading to more limited growth and lower resistance to disease. Both the biological and the chemical content of the suspended material will react with the dissolved oxygen in the water, which may result in oxygen depletion. Toxic metals and organics, pathogens and viruses absorbed or adsorbed to fine-grained particulates in the material proposed for discharge may be biologically available to organisms in the water column or upon settling to the substrate. When suspended particulate levels are raised significantly above background levels by discharges, they create turbid plumes which are highly visible and aesthetically displeasing. The adverse impacts caused by such discharges depend upon the relative increase in suspended particulates above the amount occurring naturally, the current patterns, water levels and fluctuations

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present when such discharges occur, the volume and rate of the discharge, and the seasonal timing of the discharge.

(c) *Guidelines to minimize impacts.* In addition to the consideration of alternatives in § 230.10(a), the Guidelines to minimize impacts as described in § 230.10(d), and water dependency in § 230.10(e), specific measures to minimize the impacts of suspended particulates include, but are not limited to:

(1) Using silt screens or other appropriate filtration methods to confine suspended particulates to a small area where settling or removal can occur.

(2) Making use of currents and circulation patterns to mix, disperse and dilute the discharge in order to expedite reduction in the level of suspended particulates. Configuration of the pipeline at the discharge site can minimize turbidity levels.

(3) Minimizing water column turbidity by using a submerged diffuser system. The same effect can be accomplished to some extent by submerging pipeline discharges.

(4) Utilizing chemical flocculants to enhance the deposition of suspended particulates in diked disposal areas.

(5) Discharging at times of the year which will minimize adverse effects on the aquatic ecosystem.

(6) Adjusting the volume and rate of discharge to minimize the adverse effects of suspended particulates.

§ 230.32 Water.

Water is the liquid phase of the aquatic ecosystem, including wetlands, in which organic and inorganic constituents are dissolved or suspended. It is contained by the substrate to form a dynamic life-supporting system. Water clarity, nutrient and chemical content, color, odor, taste, dissolved gas levels, pH, and temperature contribute to its life-sustaining capabilities.

(a) *Environmental characteristics and values.* Physical and chemical characteristics of the water vary among water bodies and among strata in a single water mass. Vertical stratification from surface to substrate, and lateral stratification between shorelines or banks are also characteristic of certain water bodies. Aquatic organisms and communities are closely adapted both to certain ranges in the physical and chemical properties of water, and to the stratification patterns of the water body. Environmental values of water include its importance as a life-supporting system for communities of aquatic organisms, such as in a drinking water supply, an agricultural and manufacturing water supply, a transportation medium, a place for recreation, education, aesthetics, and food supply, derived from fish, shellfish, and wildlife.

(b) *Possible loss of characteristics and values.* The discharge of dredged or fill material can change the water chemistry and the physical characteristics of the water body at the disposal site through the introduction of chemical constituents in suspended or dissolved form that do not occur there naturally. Changes in the clarity, color, odor, and taste of water and the toxic or hazardous pollutants contained in it can reduce or eliminate the suitability of water bodies for communities and populations of aquatic organisms, and for human consumption, recreation, aesthetics, and amenities. The introduction of nutrients to the water column as a result of the discharge can create a high biochemical oxygen demand (BOD). The dissolved oxygen concentration is reduced as a result of BOD, affecting the survival of many aquatic organisms. Increases in nutrients can favor one group of organisms to the detriment of other more desirable types, resulting in bad health effects, objectionable tastes and odors, and other nuisances.

(c) *Guidelines to minimize impacts.* In addition to the consideration of alternatives in § 230.10(a), the Guidelines to minimize impacts described in § 230.10(d), and water dependency in § 230.10(e), specific measures to minimize the impacts of suspended particulates include, but are not limited to:

(1) Using upland disposal sites and retaining or treating runoff to remove dissolved pollutants before they reach waters of the U.S. when determined to be necessary to protect the aquatic ecosystem.

(2) Using lined or impervious containment areas in waters of the U.S. to prevent release of the discharged material to the receiving water column.

(3) Using a submerged diffuser system or other subsurface disposal method to minimize release of discharged material to the receiving water column.

(4) Adding treatment substances to the discharged material. For instance, the oxygen loss from the water column associated with biological and chemical oxygen demand can be reduced by addition of oxygen to the discharged material.

§ 230.33 Current patterns and water circulation.

Current patterns and water circulation are the physical movements of water in the aquatic ecosystem, including wetlands. Currents and circulation are in response to celestial, gravitational, atmospheric and geologic forces as modified by basin shape and cover, physical and chemical characteristics of water strata and masses, and energy dissipating factors.

(a) *Environmental characteristics and values.* Current patterns and water circulation act to transport, mix, and dilute dissolved and suspended chemical constituents in the aquatic ecosystem. They transport accumulated detritus and food organisms, dissolved nutrients and gases, eggs, sperm, and progeny of animals, seeds and plant fragments, larvae, and young upon which communities and individual populations of organisms depend. Current patterns and water circulation also furnish directional orientation for migratory species, moderate temperature extemes and otherwise influence temperature, and directly or indirectly affect navigation and recreation in the waters of the U.S.

(b) *Possible loss of environmental characteristics and values.* The discharge of dredged or fill material can modify current patterns and water circulation by obstructing flow, changing the direction or velocity of water flow and circulation, or otherwise reducing the reach of a water body. As a result, adverse changes can occur in location, structure, and dynamics of aquatic communities; shoreline and substrate erosion and deposition; the deposition of suspended particulates; the rate of mixing of dissolved and suspended components of the water body; and water stratification.

(c) *Guidelines to minimize impacts.* In addition to the consideration of alternatives in § 230.10(a), the Guidelines to minimize impacts in § 230.10(d), and water dependency in § 230.10(e), specific measures to minimize impacts on current patterns and water circulation include, but are not limited to:

(1) Distributing discharge material widely and in a thin layer at the disposal site to maintain natural substrate contours and elevation.

(2) Where mounding is an acceptable alternative engineering the shape and orientation of the mound to minimize the surface that constitutes a cross sectional barrier to the current and the vertical portion of the water column occupied by the mound. The manipulation of natural bottom contours should be considered in minimizing the size of the mound.

(3) Ensuring water circulation by use of properly designed culverts, pilings, suspension bridges, etc., for structures; and discontinuous mounds for open water discharge. (See Section 230.46 Riffles and Pools for discussion of channelization).

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(4) Selection of the sites of impoundments associated with dams to minimize distortion of unique characteristics of riverine ecosystems caused by the inevitable drastic modification of current patterns and water circulation.

§ 230.34 Normal water fluctuations.

Normal water fluctuations in a natural system consist of daily tidal fluctuations, seasonal fluctuations, and annual fluctuations in water level. Biological and physical components of these systems are attuned to periodic water fluctuations.

(a) *Environmental characteristics and values.* Natural water fluctuations affect the water depth, water quality, and salinity conditions to which plants and animals in an aquatic area are closely adapted. They often play an important role during periods of spawning, juvenile development, nesting and feeding. Water fluctuations provide nutrients and water to aquatic biota and transport detritus and seeds, especially to wetlands flushed by tides. Periodic inundation excludes upland plant invasion and thus perpetuates wetland plant communities, which may help to minimize erosion, retard high water runoff (as from floods and storm surges) and promote accretion of the substrate.

(b) *Possible loss of environmental characteristics and values.* Discharge of dredged or fill material can alter the normal water-level fluctuation pattern of an area resulting in prolonged periods of high or low water, exaggerated extremes of high and low water, or a static, nonfluctuating water level. Depending on the condition created by the disposal activity, such water level modifications can change salinity patterns, increase erosion or sedimentation, aggravate water temperature extremes, and upset the nutrient and dissolved oxygen balance of the aquatic ecosystem. In addition, these modifications can alter or destroy communities and populations of aquatic animals and vegetation, induce replacement by nuisance growth, modify habitat, reduce food supplies, restrict movement of aquatic fauna, destroy spawning areas, and change adjacent or downstream areas.

(c) *Guidelines to minimize impacts.* In addition to the consideration of alternatives in § 230.10(a), the Guidelines to minimize impacts in § 230.10(d), and water dependency in § 230.10(e), specific measures to minimize impacts on current patterns and water circulation include, but are not limited to:

(1) Designing access roads and channel spanning structures using culverts, open channels, and diversions that will pass both the high and low stages of fluctuating water flows and maintain circulation and faunal movement.

(2) Designing the discharge of dredged or fill material to minimize or prevent the creation of standing bodies of water in areas of fluctuating water levels, or the drainage of areas previously subject to such fluctuations. (See § 230.46 Riffles and Pools for discussion of channelization).

§ 230.35 Salinity.

Salinity gradients form where salt water from the ocean meets and mixes with fresh water from land. These gradients exist in response to the natural forces that create and move masses of water.

(a) *Environmental characteristics and values.* The distribution of many aquatic species is associated with the salinity gradient of an aquatic area. Plant and animal communities adapted to particular salinity gradients form specialized communities within the larger aquatic ecosystem. Species, such as brown and white shrimp, spawn in the ocean, then migrate to nursery and maturation areas in the low-salinity waters of the bays, estuaries, and coastal marshes; their spawning and migratory behavior being closely adapted to the salinity gradient in certain aquatic areas. The manner in which fresh and salt water mix in estuarine areas is an important factor contributing to the role estuaries play as sediment traps. This is determined by the relative magnitude of the river flow and the tidal flow. In a river-dominated estuary, a salt-wedge develops and salt water flows upstream along the bottom while fresh water flows seaward in the upper levels. The upstream edge of this salt-wedge marks the point of maximum sedimentation. This upstream edge will migrate up and down the estuary yearly and seasonally in response to changes in the volume of river flow. In an estuary dominated by tidal flow, the salt wedge is destroyed and more thorough mixing occurs. There is a salinity gradient from the upstream to the downstream portion of the estuary, as well as vertically from surface to substrate, which is characteristic of the estuary.

(b)(1) *Possible loss of environmental characteristics and values.* Adverse impacts from dredged or fill material are principally caused by obstructions that divert or restrict the flow of either the fresh or salt water. These diversions and restrictions can effect permanent changes in the local areas by causing a shift in the salinity patterns.

(2) Partial blocking of the entrance to an estuary or river mouth will restrict the movement of the salt water into and out of that area. This can effectively lower the volume of salt water available for mixing that estuary. The circulation pattern will be altered, the salinity gradient will move downstream, sedimentation is displaced, and the associated aquatic biota must adjust to the new conditions.

(3) In the freshwater zone, disposal operations in the upstream regions can have equally adverse impacts. Any reduction in the volume of fresh water moving into the estuary will affect the location and type of mixing, changing the characteristic salinity pattern. The circulation pattern is altered, the salinity gradient and/or salt-wedge moves upstream, municipal water supplies can be affected, sedimentation areas are displaced, and the biota must move to new locations to find the portion of the salinity gradient to which they are adapted.

(c) *Guidelines to minimize impacts.* Adherence to the Guidelines for the protection of current patterns and water circulation and normal water fluctuations, §§ 230.33 and 230.34 will protect salinity patterns and the environmental values they support.

Subpart E—Special Aquatic Sites

§ 230.40 Sanctuaries and refuges.

Sanctuaries and refuges consist of areas designated and managed principally for the preservation of fish and wildlife.

(a) *Values.* Sanctuaries and refuges maintain and enhance the habitat for resident and transient fish and wildlife populations. They serve the functions of providing food resources and protective cover, and provide areas for reproduction and nursery grounds. Sanctuaries and refuges are managed to control predator populations and provide protection from interferences by man.

(b) *Possible loss of values.* The discharge of dredged or fill material can reduce suitable habitats either temporarily or permanently, interfere with spawning, migratory or other life stage activities and by contamination, concealment or destruction, reduce the availability of food for fish and wildlife. Discharges of dredged and fill material may increase incompatible human presence by providing persons ready access to remote areas or by requiring frequent maintenance activity. Modification of the environment by dredge and fill operations may provide a habitat for predators or competitively exploitive species of plants and animals.

(c) *Guidelines to Miminize Impacts.* In addition to the consideration of

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alternatives in § 230.10(a), the Guidelines to minimize impacts as described in § 230.10(d), and water dependency in § 230.10(e), specific Guidelines to minimize adverse effects on sanctuaries and refuges include, but are not limited to:

(1) Selecting sites that will not result in long-term changes in valuable fish and wildlife habitat.

(2) Selecting sites that will not increase incompatible human activity causing significant impacts on fish and wildlife, or require the need for frequent maintenance activity in remote fish and wildlife areas.

(3) Selecting sites or managing discharges in a way to prevent or to control the creation of habitat for undesirable predators or competitive species of plants or animals.

(4) Not discharging at times during the breeding, migratory and other critical life stages of resident of transient fish, wildlife and other aquatic organisms.

(5) Enhancing habitat characteristics of the area, in a manner consistent with management practices.

(6) The specific Guidelines related to other special aquatic sites which exist within a sanctuary or refuge should also be examined.

(d) *Special determinations.* In addition to the determinations required by § 230.20 and § 230.30, special determinations where sanctuaries and refuges may be affected by discharges of dredged or fill material include whether the discharge will:

(1) Disrupt the breeding, spawning, migratory or other critical life states of resident or transient fish and wildlife;

(2) Create ready human access to remote aquatic areas;

(3) Create the need for frequent maintenance activity;

(4) Result in the establishment of undesirable competitive species of plants and animals;

(5) Modify the sanctuary or refuge management practices by changing the balance of water and land areas needed to provide cover, food, and other fish and wildlife habitat requirements;

(6) Be acceptable to sanctuary or refuge managers or supporters of the refuge or sanctuary;

(7) Allow for subsequent modification for restoration or habitat development of existing habitat.

§ 230.41 Parks, national and historical monuments, national seashores, wilderness areas, research sites, and similar preserves.

These nature preserves consist of areas designated and managed for their aesthetic, educational, historical, recreational, or scientific value.

(a) *Values.* Managed use of these natural areas is designed to preserve them in their natural states. The management of these areas ensures the general public continued access to sites of historical, educational, recreational and scientific importance while protecting them from overuse. The restriction of certain activities in areas valuable for scientific research preserves those sites in their natural states for the collection of scientific information.

(b) *Possible loss of values.* The discharge of dredged or fill material into such areas could modify the aesthetic, educational, historical, recreational and/or scientific qualities thereby reducing or eliminating the uses for which such sites are set aside and managed.

(c) *Guidelines to minimize impacts.* In addition to the consideration of alternatives in § 230.10(a), the Guidelines to minimize impacts described in § 230.10(d), and water dependency in § 230.10(e), specific Guidelines to minimize adverse effects on these designated natural areas include but are not limited to:

(1) Selecting a disposal site that will not result in a significant or irreversible loss in the specific values for which an area is being managed and protected.

(2) Specific Guidelines for other aquatic sites which exist within a preserve should also be examined.

(d) *Special determinations.* In addition to the determinations required by § 230.20 and § 230.30, special determinations, where these designated natural areas may be affected by discharges of dredged or fill material, include whether the discharge will:

(1) Modify management practices for the park, National or historical monument, National seashore, wilderness area, or research site under consideration for discharge.

(2) Be acceptable to users and managers of such areas.

(3) Allow for subsequent modification for restoration or habitat development of existing areas.

§ 230.42 Wetlands.

Wetlands consist of areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.

Comment: Wetlands are the subject of Federal Executive Order No. 11990, Federal programs, and State law and programs in addition to section 404 of the Act. As a result, a number of wetland definitions have been codified or otherwise formally published and information is being collected and organized into wetland classification systems. The definition and classification systems differ in at least some particulars to accomodate or emphasize specialized needs. In these Guidelines, wetlands (§ 230.42) are distinguished from mud flats (§ 230.43) and vegetated and unvegetated shallows (§ 230.44) although by some classification systems all of these systems would be classified as wetlands. In addition, in particular circumstances, portions of sloughs, prairie potholes, wet meadows, river bottomlands, and other areas may be wetlands under section 404. Permanently inundated areas such as vegetated and unvegetated shallows (§ 230.44) and riffles and pools (§ 230.46) are considered to be open water. Where open water exists, wetlands, mud flats, sand flats, beaches, etc., constitute the transition to upland. The margin between wetland and open water can best be established by specialists familiar with the local environment, particularly where emergent vegetation merges with submerged vegetation over a broad area in such places as the lateral margins of open water, in headwaters, in rainwater catch basins, and at groundwater seeps. The landward margin of wetlands also can best be identified by specialists familiar with the local environment when vegetation from the two regions merges over a broad area. Wetland vegetation consists of plants that require wet soils to survive (obligate wetland plants) as well as plants, including certain trees, that gain a competitive advantage over others because they can tolerate prolonged wet soils conditions and their competitors cannot. In addition to plant populations and communities, vegetated wetlands are delimited by hydrological and physical characteristics of the environment. These characteristics should be considered when information about them is needed to supplement information available about vegetation, or where wetland vegetation has been removed or is dormant.

(a) *Values.* Wetlands serve important natural biological functions. They can support high biological productivity, especially in estuarine systems. Some wetlands may exchange nurtients through water circulation patterns thereby affecting adjacent ecosystems. Wetlands provide habitat for resident aquatic and terrestial species. Many nonresident species depend on wetlands

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for food and as habitat at certain stages in their life cycle. For example, wetlands function as spawning and nursery areas for many fish species, and resting areas for migratory waterfowl. Functioning as a buffer zone, wetlands shield upland areas from wave action, erosion, and storm damage. Some wetlands also serve as storage areas for storm and flood waters. Wetlands may also have beneficial effects on water quality. Pollutants in runoff from surrounding upland areas or in water flushing wetlands may be retained or converted to innocuous forms protecting water quality in receiving waters. Wetlands influence natural drainage characteristics, water circulation, and sedimentation patterns. Wetlands may serve as aquifer recharge areas.

(b) *Possible loss of values.* The discharge of dredged or fill material in wetlands is likely to damage or destroy habitat or adversely affect the biological productivity of wetland eocsystems by smothering, dewatering, permanently flooding, or altering periodicity of water movement. Wetland vegetation is extremely sensitive to changes in substrate elevation. The addition of dredged or fill material may destroy wetland vegetation or result in advancement of succession to dry land species. Dredged or fill activities may reduce or eliminate nutrient exchange by a reduction of the system's productivity, or altering current patterns and changing velocities. Disruption of the wetland system can result in degradation of water quality. Discharging fill material in wetlands as part of municipal, industrial or recreational development may modify the capacity of wetlands to retain and store floodwaters and to serve as a buffer zone shielding upland areas from storm damage and erosion. The discharge of dredge and fill material in wetlands can obstruct sheet flow or circulation patterns that flush large expanses of adjacent wetland systems. When disruptions in flow and circulation patterns occur, apparent minor loss of wetland acreage may result in major losses through secondly impacts.

(c) *Guidelines to minimize impacts.* In addition to the consideration of alternatives in § 230.10(a), Guidelines in minimize impacts described in § 230.10(d), and water dependency in § 230.10(e), special Guidelines to minimize adverse effects on wetlands include, but are not limited to:

(1) Restoring the elevation, substrate type, and circulation patterns as soon as possible following the completion of any necessary construction or other discharge activity in a wetland to provide conditions for natural restoration of vegetation in disturbed areas.

(2) Restoring or developing habitat in disrupted wetlands by revegetation with the native wetland species removed by the activity.

(3) Establishing new wetlands with the disposal material where suitable sites and conditions exist and other components of the ecosystem such as vegetated shallow water areas will not be disrupted.

(4) Using machinery and techniques that are especially designed to reduce damage to wetlands. This may include machinery with specially designed wheels or tracks, machines equipped with devices that scatter rather than mound excavated materials, and the use of mats under heavy equipment to reduce wetland surface compaction and rutting.

(5) Limiting the number and extent of construction access roads and temporary fills in wetlands that may be required for the dredge or fill activity.

(6) Implementing habitat development which is compatible with other parts of the ecosystem. These measures may include but are not limited to:

(i) Establishing fish or wildlife habitat or food crop vegetation at the disposal site;

(ii) High mounding the discharged material in confined sites to create wildlife habitat.

(7) Discharging at times of the year which will minimize adverse effects on the wetlands ecosystem.

(d) *Special Determinations.* In addition to the determinations required by § 230.20 and § 230.30, special determinations where wetlands may be affected by discharges of dredged or fill material include whether the discharge will individually or cumulatively:

(1) Significantly change or affect the productivity or the nutrient exchange capability of a wetland area.

(2) Significantly change the capacity of a specific wetland type for protecting other areas from wave actions, erosion, or storm damage.

(3) Significantly change the capacity of a wetland to store storm and flood waters.

(4) Significantly change the aquifer recharge capability of a wetland.

(5) Significantly change the wetland as habitat for fish and wildlife.

§ 230.43 Mud flats.

Mud flats are located along the sea coast and in coastal rivers to the head of tidal influence and in inland lakes, ponds, and riverine systems. They are broad, flat areas, which when inundated are subject to the resuspension of bottom sediments by wind induced wave action. Coastal mud flats are exposed at extremely low tides and inundated at high tides with the water table at or near the surface of the substrate. The substrate of mud flats contains organic material and particles smaller in size than sand. They are either unvegetated or vegated only by algal mats.

(a) *Values.* Mud flats serve as habitats for shellfish and other invertebrates. They serve as nursery, spawning, and foraging areas for many fish, other aquatic species, birds, and other animals. Primary productivity in mud flats is centered in algal mats and diatoms. The decomposition of organic material in mud flats by chemical and biological processes contributes nutrients to the water column. Mud flats delay and thereby reduce the adverse effects of storm surge and runoff from surrounding uplands.

(b) *Possible loss of values.* The discharge of dredged or fill material can cause changes in water circulation pattern which may disrupt periodic inundation or permanently flood or dewater the mud flat. Such changes can deplete or eliminate mud flat biota, foraging areas, and nursery areas. Changes in inundation patterns also can affect the chemical and biological decomposition processes occurring on the mud flat and change the deposition of suspended material affecting the productivity of the area. Changes may reduce the mud flat's capacity to dissipate storm surge runoff.

(c) *Guidelines to minimize impacts.* In addition to the consideration of alternatives in § 230.10(a), the guidelines to minimize impacts described in § 230.10(d), and water dependency in § 230.10(e), special Guidelines to minimize adverse effects on mud flats include, but are not limited to:

(1) Designing the discharge to avoid a disruption of the periodic inundation patterns.

(d) *Special determinations.* In addition to the determinations required by § 230.20 and § 230.30, special determinations where coastal mud flats may be affected by discharges of dredged or fill material include whether the discharge will:

(1) Significantly change the periodic inundation patterns, resulting in an increase in the rate of erosion or accretion.

(2) Significantly change the periodic inundation patterns, resulting in adverse modifications of the mud flat as fish, shellfish and wild life habitat.

(3) Significantly change the periodic inundation patterns, resulting in

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modification of the chemical and biological decomposition process of the mud flat.

(4) Significantly change the periodic inundation patterns, resulting in a reduction of the storm surge dissipating capacity of the mud flat.

§ 230.44 Vegetated and unvegetated shallows.

Vegetated shallows are permanently inundated areas that under normal circumstances support rooted aquatic vegetation such as turtle grass and eelgrass as well as a number of freshwater species. Unvegetated shallows are permanently inundated near shore areas.

(a) *Values.* Vegetated shallows are highly productive areas where the productivity is centered in the vegetation. Such vegetated beds provide food, cover, spawning, nursery, and forage areas for many aquatic organisms as well as wildlife. Harvestable aquatic organisms are concentrated in and around such beds. These vegetated shallows stabilize bottom materials and decrease turbidity and channel shoaling. Unvegetated shallows furnish benefits of food, spawning and nursery areas, and forage for many aquatic organisms, as well as wildlife. Both types of shallows constitute a buffer to protect shorelines from erosion and wave action.

Comment: Vegetation in shallow water does not always constitute an integral component of a productive, balanced ecosystem in a special aquatic site. Rooted vascular vegetation may erupt in response to excessive nutrients introduced by man directly and indirectly, because it is an exotic species with inadequate natural controls, or for other reasons. In extreme cases, when ponds or navigation channels are completely weed-choked by vascular vegetation, the nuisance factor is clear and the values of vegetated shallows are largely negated. The ecology of shallow water vegetation is complex and deserves professional consideration to prevent damage to productive natural systems while allowing control of nuisance growths.

(b) *Possible loss of values.* The discharge of dredged or fill material can smother vegetation and benthic organisms. It may also create unsuitable conditions for their continued vigor by changing water circulation patterns, releasing nutrients that increase algal populations, releasing chemicals that adversely affect plants and animals, increasing turbidity levels, or by reducing light penetration. The discharge of dredged or fill material may reduce the value of vegetated and unvegetated shallows as nesting, spawning, nursery, cover, and forage areas, as well as their value in protecting shorelines from erosion and wave actions.

(c) *Guidelines to minimize impacts.* In addition to the consideration of alternatives in § 230.10(a), the Guidelines to minimize impacts in § 230.10(d), and water dependency in § 230.10(e), specific Guidelines to minimize adverse impacts in vegetated and unvegetated shallows include but are not limited to:

(1) Locating and confining the discharge to avoid smothering productive beds of vegetation and concentrations of benthic life.

(2) Determining the point of discharge, the discharge site, and the method of discharge into the water column which will minimize the extent of any plume and the deposition zone where the discharge would adversely affect the vegetation, aquatic organisms, and other wildlife in a vegetated or unvegetated shallow.

(3) Locating and otherwise designing the discharge to avoid significant changes in water circulation patterns which are essential to the productivity of the shallow area.

(4) Timing the discharge to avoid interferences with the spawning, nursery, and nesting activities of aquatic organisms and associated wildlife.

(5) Restoring or transplanting vegetated beds where beneficial and where conditions at the site permit.

(d) *Special determinations.* In addition to the determinations required by § 230.20 and § 230.30, special determinations where vegetated and unvegetated shallows may be affected by discharges of dredged or fill material include whether the discharge will:

(1) Smother vegatated beds or benthic organisms.

(2) Significantly change or affect the species present or the productivity of the vegetation or the benthic organisms associated with a shallow area.

(3) Significantly change the capacity of a vegetated shallow for stabilizing bottom materials and for decreasing turbidity and channel shoaling.

(4) Significantly change the capacity of vegetated or unvegetated shallows to protect shorelines from erosion and wave action.

(5) Significantly change the capacity of the area to exchange organic matter and nutrients.

§ 230.45 Coral reefs.

Coral reefs consist of the skeletal deposit, largely of calcareous or silicaceous materials, produced by the vital activities of anthozoan polyps or other invertebrate orgamisms and include the colonies of organisms present in growing portions of the reef.

(a) *Values.* Coral reefs are highly productive areas where the productivity is centered in the reef building organisms. Coral reefs provide food, cover, spawning, nursery, and forage areas for many species of highly specialized aquatic organisms. They constitute a unique environment in which many rare forms or brilliantly colored fish and other organisms are concentrated. They serve as a site at which such organisms can be observed under natural conditions by scientists and others.

(b) *Possible loss of values.* The discharge of dredged or fill material can adversely affect colonies of reef building organisms by releasing contaminants such as hydrocarbons into the water column, by burying them, by reducing light penetration through the water, and by increasing the level or suspended particulates. Coral organisms are extremely sensitive to even slight reductions in light penetration or increases in suspended particulates. These adverse effects will cause a loss of productive colonies which provides habitat for many species of highly specialized aquatic organisms.

(c) *Guidelines to minimize impacts.* In addition to the consideration of alternatives in § 230.10(a), the Guidelines to minimize impacts in § 230.10(d), and water dependency in § 230.10(e), specific Guidelines to minimize adverse impacts on coral reefs include, but are not limited to:

(1) Selecting sites or managing discharges to confine and minimize the release of suspended particulates which would result in reductions in light penetration or increase in turbidity levels in the proximity of a coral reef. Water current and circulation patterns which may transport material into or across a coral reef must be considered.

(d) *Special determiniations.* In addition to the determinations required by § 230.20 and § 230.30, special determinations where coral reefs may be affected by discharges of dredged or fill material include whether the proposed discharge will:

(1) Smother colonies of reef building organisms.

(2) Significantly change or affect the productivity of reef building colonies by reducing light penetration or increasing water turbidity.

(3) Result in significant reductions in light penetration or increases in water turbidity due to the transportation of suspended particulates by current and circulation patterns onto or across a coral reef.

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§ 230.46 Riffles and pools.

Upland and steep gradient streams generally have alternating segments of riffles and pools. Riffles are well oxygenated shallow areas with coarse substrates. Pools are areas between riffles where water generally is deeper and stream velocity is slower, allowing for the settling of particulates to the substrate.

(a) *Values.* (1) Riffles and pools are vital habitats for fresh water aquatic life. The abundance of riffles and pools and the ratio of riffles to pools are important factors in the kinds and amounts of habitat available to stream communities. Riffles aid in the oxygenation and filtration of streams. They are valuable spawning areas for fish requiring well-oxygenated areas for egg maturation. In addition, riffles support complex and productive habitats inhabited by algae, worms, snails, crustacea, aquatic insects, and fish. These organisms are vital links in the aquatic food chain. Drift of riffle-related invertebrates and organic matter aids in repopulating downstream areas.

(2) Pools, characterized by low stream velocity and greater depth, act as stream sedimentation basins and provide shelter and feeding habitat for mature fish. Pools and meanders act to control stream velocity and water discharge rates.

(b) *Possible loss of values.* (1) Discharge of dredged or fill material can eliminate riffle and pool areas by displacement, hydrologic modification, or sedimentation. Activities which affect riffle and pool areas or riffle/pool ratios reduce the aeration and filtration capabilities at the discharge site and downstream, and may retard any repopulation of downstream waters.

(2) The discharge of dredged or fill material which alters stream hydrology may cause scouring or sedimentation of riffles and pools. Sedimentation induced through hydrological modification or as a direct result of the deposition of unconsolidated dredged or fill material may clog riffle and pool areas, destroy habitats, and create anaerobic conditions. Eliminating pools and meanders by the discharge of dredged or fill material through channelization or otherwise can reduce water holding capacity of streams and cause rapid runoff from a watershed. Rapid runoff can deliver large quantities of flood water in a short time to downstream areas resulting in the destruction of natural habitat, high property loss, and the need for further hydrological modification.

(c) *Guidelines to minimize impacts.* In addition to the considerations of alternatives in § 230.10(a), the Guidelines to minimize impacts as described in § 230.10(d), and water dependency in § 230.10(e), specific Guidelines to minimize adverse impacts on riffles and pools include, but are not limited to:

(1) Selecting an upland disposal site where available and where determined to be an environmentally satisfactory alternative (§ 230.10(a)).

(2) Locating and containing unconsolidated dredged or fill material to prevent its deposition in riffle and pools areas.

(3) Minimizing or preventing changes in stream hydrology which would cause significant increases in scouring or sedimentation of riffles and pools.

(d) *Special determinations.* In addition to determinations required by § 230.20 and § 230.30, special determinations where riffle and pools may be affected by discharges of dredged or fill material include whether the discharge will:

(1) Result in the alteration or elimination of riffle and pools areas and their value as aeration and filtration zones.

(2) Modify stream hydrology causing increased scouring or sedimentation of riffles and pools.

(3) Increases sedimentation in pool areas.

(4) Reduce the water holding capacity of streams.

(5) Result in the deposition of unconsolidated material on coarse substrates, reducing the value of riffle areas as aeration and filtration zones and as habitat for specially adapted stream communities.

Subpart F—Communities and Populations of Organisms Dependent on Water Quality

§ 230.50 Mollusks.

Mollusks consist of oysters, clams, scallops, and other members of the Order Mollusca.

(a) *Values.* Mollusks serve as an important link in the food chain for many species of fish, birds and mammals. Some species rely on mollusks as their primary food source. Like most aquatic and wetland biota, mollusks are valued as contributors to the ecological diversity of the aquatic and wetland environment. In addition, they contribute directly to the economy and diet of persons in the form of food, agricultural supplies, and manufactured items.

(b) *Possible loss of values.* Discharge of dredged and fill material may result in the debilitation or death of mollusks by smothering, exposure to chemical contaminants in dissolved or suspended form, exposure to high levels of suspended particulates, reduction in food supply, or alteration of the substrate upon which they are dependent. Mollusks are particularly sensitive to the discharge of material during periods of reproduction and growth and development. Mollusks can be rendered unfit for human consumption by tainting, by ingestion and retention of pathogenic organisms, viruses, heavy metals or persistent synthetic organic chemicals, or through the stimulation of toxin production.

(c) *Guidelines to minimize impacts.* In addition to the considerations of alternatives in § 230.10(a), the Guidelines to minimize impacts in § 230.10(d), and water dependency in § 230.10(e), specific Guidelines to minimize adverse impacts on mollusks include, but are not limited to:

(1) Selecting discharge sites removed from areas of concentrated mollusk populations.

(2) Containing the discharge to prevent or minimize the release of contaminated material and suspended particulates in the proximity of mollusk populations (see measures described in § 230.10(d)).

(3) Timing the discharge to minimize or prevent interference with the reproductive success of mollusks or the growth and development of juvenile forms.

(d) *Special determinations.* In addition to the determinations required by § 230.20 and § 230.30, special determinations where mollusk populations may be affected by the discharge of dredged or fill material include whether the discharge will:

(1) Smother concentrated mollusk populations.

(2) significantly change or affect the suitability of the substrate as habitat for mollusk populations.

(3) Result in the chemical contamination of mollusk populations, reducing their value as a recreational or commercial food source.

(4) Significantly impair the filter-feeding capacities of mollusk populations due to increased levels of suspended particulates.

(5) Significantly interfere with the reproductive success of mollusk populations or the growth and development of juvenile forms through exposure to chemical contaminants or suspended particulates, or by other means.

§ 230.51 Fish, crustacea, and food chain organisms.

Aquatic food chain organisms include, but are not limited to, finfish, crustacea,

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annelids, mollusks, planktonic organisms, and the plants and animals on which they feed. All forms and life stages of an organism, as well as its geographic range, are included in this category.

(a) *Values.* Fish, crustacea, and aquatic food chain organisms exhibit diverse adaptation to the aquatic ecosystem, and perform specific functions in the food web of these ecosystems. These organisms provide vital links in the transfer of energy from primary productivity to higher trophic levels. These links ensure the continued overall productivity of the ecosystem. The production of the aquatic food chains support recreational and commercial fisheries, thereby linking man as the ultimate consumer.

(b) *Possible loss of values.* The discharge of dredged or fill material can reduce populations of fish, crustacea, and other food chain organisms directly through the release of contaminants which adversely affect adults, juveniles, larvae and eggs. Suspended particulates settling on adhesive or buried eggs can smother the eggs. The movement of fish and crustacea can be redirected or stopped, thus preventing the aggregation of organisms in accustomed places such as spawning grounds. Reduction of detrital feeding species can impair the flow of energy from primary consumers to higher trophic levels. The reduction or potential elimination of food chain organism populations decreases the overall productivity and nutrient export capability of the ecosystem.

(c) *Guidelines to minimize impacts.* In addition to the consideration of alternatives in § 230.10(a), the Guidelines to minimize impacts as described in § 230.10(d), and water dependency in § 230.10(e), specific measures to minimize impacts on fish, crustacea, and other food chain organisms include, but are not limited to:

(1) Following procedures to minimize or reduce the amount of suspended particulates in the water column as described in § 230.31(c)(1), (2) and (3).

(2) Discharging dredged or fill material that contains contaminants which are potentially bioaccumulative in the tissues of food chain organisms away from areas of food chain productivity.

(3) Selecting discharge methods and disposal sites to minimize or prevent interference with the movement of fish, crustacea, and other food chain organisms, or reductions in the value of aquatic habitat due to changes in patterns of water flow and circulation. Discharge material may be spread or scattered on the disposal site to reduce the effects of mounting or changing elevation. Current patterns may be used to mix, disperse, and dilute the discharge.

(4) Not discharging during periods of breeding, migration and other critical life stages of resident or transient aquatic food chain organisms, nor during spawning cycles of finfish.

(5) Restoring aquatic food chain organism habitat conditions following the completion of the discharge or construction.

(6) Enhancing aquatic food chain organism habitat where site conditions are feasible.

(7) Selecting sites or managing discharges in a way to prevent or control the creation of habitat for undesirable predators or competitive species of plants and animals.

(d) *Special determinations.* In addition to the determinations required by § 230.20 and § 230.30 special determinations where fish, crustacea and other food chain organisms may be affected by discharges of dredged or fill material include whether or not the discharge will:

(1) Disrupt the breeding, spawning, migratory or other critical life stages of aquatic food chain organisms.

(2) Result in the establishment or proliferation of undesirable competitive species of plants and animals, at the expense of resident species.

(3) Change or affect the productivity or the nutrient export capability of an area.

§ 230.52 Wildlife.

Wildlife associated with aquatic ecosystems, including wetlands, are resident and transient mammals, birds, reptiles, and amphibians, among others.

(a) *Values.* (1) All species of wildlife are valuable members of the particular aquatic ecosystem to which they belong. The interactions of a species with the vegetation and other members of the community are integral to the continued functioning of the ecosystem.

(2) Wildlife species and communities are of special scientific, educational, recreational, and aesthetic value to the human population, providing opportunities for nature study, research, bird-watching, photography and hunting. Wildlife species additionally serve as sensitive indicators of changes in air and water quality. Some species of wildlife are of economic value, as in the trapping of furbearers, and the hunting of waterfowl.

(b) *Possible loss of values.* The discharge of dredged or fill material can result in the loss of breeding and nesting areas, escape cover, and preferred food sources for resident and transient wildlife species associated with the aquatic ecosystem. These adverse impacts upon wildlife habitat may result from changes in water levels, water flow and circulation, salinity, chemical content, and substrate characteristics and elevation. Increased water turbidity can adversely affect wildlife species which rely upon sight to feed, and disrupt the respiration and feeding of aquatic wildlife and food chain organisms. The availability of contaminants in the discharge of dredged or fill material may lead to the bioaccumulation of such contaminants in aquatic wildlife. Changes in such physical and chemical factors of the environment may favor the introduction of undesirable plant and animal species at the expense of resident species and communities. Losses in plant and animal species diversity may disrupt the normal functioning of the aquatic ecosystem, leading to reductions in biological productivity.

(c) *Guidelines to minimize impacts.* In addition to the consideration of alternatives in § 230.10(a), the Guidelines to minimize impacts as described in § 230.10(d), and water dependency in § 230.10(e), specific Guidelines to minimize adverse effects on wildlife include, but are not limited to:

(1) Selecting discharge methods and disposal sites to minimize or prevent interference with the movement of wildlife, or reductions in the value of aquatic or wetland habitat due to changes in patterns of water flow and circulation.

(2) Selecting a discharge site that will not result in increased human access, or require the need for frequent maintenance activity in remote or highly productive wildlife habitat.

(3) Not discharging during periods of breeding, migration, and other critical life stages of resident or transient wildlife species, or during the spawning cycles of fish, upon which some wildlife depend for food.

(4) Restoring aquatic wildlife habitat conditions following the completion of the discharge or construction activity.

(5) Developing or restoring aquatic wildlife habitat where site conditions are feasible.

(d) *Special determinations.* In addition to the determinations required by § 230.20 and § 230.30, special determinations where wildlife may be affected by discharges of dredged or fill material include whether the discharge will:

(1) Significantly change or affect breeding and nesting grounds, resting areas and escape cover, and preferred food sources for wildlife.

(2) Result in the introduction of undesirable plant or animal species that significantly affect resident species and communities.

(3) Result in significant changes in wildlife populations including abundance and diversity.

(4) Significantly affect the scientific, educational, aesthetic, and recreational values associated with wildlife communities at the disposal site.

§ 230.53 Threatened and endangered species.

An endangered species in any species which is in danger of extinction throughout all or a significant portion of its range. A threatened species is one which is in danger of becoming an endangered species in the foreseeable future throughout all or a significant portion of its range. The continued existence of any such species may be threatened by: (1) the present or threatened destruction, modification, or curtailment of its habitat or range; (2) over-utilization for commercial, sporting, scientific, or educational purposes; (3) disease or predation; (4) the inadequacy of existing regulatory mechanisms; or (5) other natural or man-made factors affecting its survival. Listings of threatened and endangered species and their critical habitats is maintained by the U.S. Fish and Wildlife Service of the Department of the Interior. The Department of Commerce has authority over some marine mammals, fish and reptiles.

(a) *Values.* Threatened and endangered species, by the fact of their scarceness and vulnerability to extinction, are of major importance in terms of historical, educational, and scientific interest. The extinction of an endangered species represents an irretrievable loss of potentially valuable scientific knowledge.

(b) *Possible loss of values.* The major impact from the discharge of dredged or fill material on threatened or endangered species is through the impairment or destruction of habitat to which these species are specially adapted. Elements of the aquatic habitat which are particularly crucial to threatened or endangered species include good quality water, spawning and maturation areas, nesting areas, protective cover, adequate and reliable food supply, and resting areas for migratory species. These elements can be adversely affected by changes in normal conditions like water clarity, chemical content, nutrient balance, dissolved oxygen, pH, temperature, salinity, current patterns and water circulation, and water fluctuation, or the physical removal of habitat.

(c) *Guidelines to minimize impacts.* In addition to the consideration of alternatives in § 230.10(a), the Guidelines to minimize impacts as described in § 230.10(d), and water dependency in § 230.10(e), the Guidelines for the protection of fish, wildlife, and other organisms (§ 230.51) should be followed, with special attention to the fact that an endangered species may be less able to withstand adverse impacts and usually is not capable of reestablishing itself. Attention should also be given to legislation which protects threatened or endangered species and their habitats.

(d) *Special determinations.* In addition to the determinations required by § 230.20 and § 230.30, special determinations where endangered and threatened populations may be affected by the discharge of dredged or fill material include whether the discharge will significantly change or affect the aquatic or wetland habitat which supports any threatened or endangered plant of animal species.

Subpart G—Human Use Characteristics

§ 230.60 Municipal and private water supplies.

Municipal and private water supplies consist of that portion of natural or open bodies of water or groundwater which is directed to an intake of a municipal or private water supply system.

(a) *Values.* The quality and quantity of water for human consumption is of paramount importance to the quality of life and social well-being.

(2) *Possible loss of values.* Water can be rendered unpalatable or unhealthy by the addition of suspended particulates, viruses and pathogenic organisms, and dissolved materials. The expense if removing such substances before delivery for consumption can be high. In addition, certain currently standard water treatment chemicals have the potential for combining with some suspended or dissolved substances to form other products that can have a toxic impact on consumers.

(b) *Guidelines to minimize impacts.* In addition to the consideration of alternatives in § 230.10(a), the Guidelines to minimize impacts as described in § 230.10(d), and water dependency in § 230.10(e), specific measures to minimize impacts on municipal and private water supplies include, but are not limited to:

(1) Selecting a disposal site removed from the vicinity of municipal and private water supply intake zones, recognizing the potential for transportation of the dredged material in the liquid or suspended particulate phases into the vicinity of a water supply intake zone. (Also, see impact minimizing measures described in § 230.31(c) and § 230.32(c)).

(2) Preventing or minimizing the dispersion of dissolved and suspended particulates released into the water column where the discharge of dredged or fill material in the proximity of a water supply intake is essential to maintaining or improving such supplies. (See measures described in § 230.31(c) and § 230.32(c).)

(c) *Special determinations.* In addition to the determinations required by § 230.20 and § 230.30, special determinations where municipal and private water supplies may be affected by discharge of dredged or fill material include whether the discharge will:

(1) Affect the quality of water supplies with respect to color, taste, odor, chemical content and suspended particulate concentration, in such a way as to reduce the fitness of the water for consumption.

(2) Affect the quantity of water available for municipal and private water supplies.

(3) Affect the cost of water treatment and purification.

§ 230.61 Recreational and commercial fisheries.

Recreational and commercial fisheries consist of harvestable fish, crustacea, shellfish, and other aquatic organisms for use by man.

(a) *Values.* Recreational and commercial fisheries make major contributions to local, state, and national economies. Recreational fishing provides opportunities for a large number of participants, each removing a small fraction of the catch. Commercial fisheries represent an important source of food and raw materials for use by man. In addition, commercial fisheries support important processing and distribution services. Both commercial and recreational fisheries support specialized equipment manufacturers and service industries. The value of recreational and commercial fisheries is reflected in the significant management and enforcement efforts which currently exist at the national and state levels.

(b) *Possible loss of values.* The discharge of dredged or fill materials can modify the characteristics of the aquatic environment, reducing the productivity of accustomed fishing grounds and dispersing certain species. The introduction of contaminants may impart undesirable taste or contaminate edible parts of the organism with pathogens or viruses, resulting in closures of fishing grounds. In addition,

populations of commercially important aquatic organisms or organisms upon which they depend for food may be reduced by the introduction of pollutants at critical stages in their life cycle that affects them directly or destroys necessary habitat. Any of these impacts can be of short duration or prolonged, depending upon the physical and chemical impacts of the discharge and the biological availability of contaminants to aquatic organisms.

(c) *Guidelines to minimize impacts.* In addition to the consideration of alternatives in § 230.10(a), Guidelines to minimize impacts as described in § 230.10(d), water dependency in § 230.10(e), and the specific measures described in § 230.51(c), specific measures to minimize impacts on recreational and commercial fisheries include, but are not limited to:

(1) Selecting discharge sites that are not recognized fishing grounds or areas upon which life-history stages of such species are not dependent.

(2) Containing the discharge to prevent or minimize the release of contaminants, such as hydrocarbons, capable of imparting undesirable tastes or odors to the flesh of edible aquatic organisms.

(3) Timing the discharge to avoid interference with critical periods in the life cycles of important harvestable aquatic organisms, and with peak seasons of commercial or recreational fishing activity.

(4) Preventing significant physical alteration of bottom profile so as not to preclude the efficient use of existing commercial fishery equipment.

(d) *Special determinations.* In addition to the determinations required by § 230.20 and the special determinations required by § 230.51(d), special determinations where recreational and commercial fisheries may be affected by the discharge of dredged or fill material include whether the discharge will:

(1) Change or affect the suitability of recreational and commercial fishing grounds as habitat for populations of edible aquatic organisms.

(2) Result in the chemical contamination of recreational or commercial fisheries.

(3) Interfere with the reproductive success of recreational and commercially important aquatic species through disruption of spawning or migration areas.

§ 230.62 Recreation.

Recreation encompasses activities undertaken for amusement and relaxation. Water related outdoor recreation requires the use, but not necessarily the consumptive use, of natural aquatic sites and resources, including wetlands.

(a) *Values.* Much of our outdoor recreation is water-dependent. A host of activities, including fishing, swimming, boating, water-skiing, racing, claming, camping, beachcombing, picknicking, waterfowl hunting, wildlife photography, bird watching and scenic enjoyment, take place on, in, or adjacent to, the water. In many parts of the country, space and resources for aquatic recreation are in great demand. Water quality is a vital factor in determining the capacity of an area to support the various water oriented outdoor recreation activities.

(b) *Possible loss of values.* One of the more important direct impacts of dredged or fill disposal is on aesthetics; more serious impacts impair or destroy the resources which support recreation activities. Among the water quality parameters of importance to recreation that can be impacted by the disposal of dredged or fill material are turbidity, suspended particulates, temperature, dissolved oxygen, dissolved materials, toxic materials, pathogenic organisms, degradation of habitat, and the aesthetic qualities of sight, taste, odor, and color. Changes in the levels of these parameters can adversely modity or destroy water use for serveral or all of the recreation activities enjoyed in any given area.

(c) *Guidelines to minimize impacts.* In addition to the consideration of alternatives in § 230.10(a), Guidelines to minimize impacts as described in § 230.10(d), and water dependency in § 230.10(e), and the specific measures described in Subparts E and F, where appropriate, specific measures to minimize impacts on recreational resources include, but are not limited to:

(1) Selecting discharge sites removed from areas of recognized recreational value.

(2) Selecting time periods of discharge that do not coincide with seasons or periods of high recreational use.

(3) Use of procedures and methods as described in § 230.31(c) and § 230.32(c) to minimize and contain the amounts of suspended particulates and dissolved contaminants, including nutrients, pathogens, and other contaminants released to the water column.

(d) *Special determinations.* In addition to the determinations required by § 230.20, and the special determinations required by Subparts E and F, where appropriate, special determinations where recreational areas may be affected by the discharge of dredged or fill material include whether the discharge will:

(1) Change or affect the suitability of an area of high recreational value to provide recreational opportunities.

§ 230.63 Aesthetics.

Aesthetics, associated with the aquatic ecosystem, including wetlands, consist of the perception of beauty by one or a combination of the senses of sight, hearing, touch, and smell. Aesthetics of aquatic ecosystems apply to the quality of life enjoyed by the general public as distinct from the value of property realized by owners as a result of access to such systems (see § 230.64).

(a) *Values.* The aesthetic values of aquatic areas are usually the enjoyment and appreciation derived from the natural characteristics of a particular area. Aesthetic values may include such parameters as the visual distinctiveness of the elements present, which may result from prominence, contrasts due to irregularity in form, line, color, and pattern; the diversity of elements present including topographic expression, shoreline complexity, landmarks, vegetative pattern diversity, waterform expression, and wildlife visability; and the compositional harmony or unity of the overall area.

(b) *Possible loss of values.* The discharge of dredged or fill material can mar the beauty of natural aquatic ecosystems by degrading the water quality, creating distracting disposal sites, inducing nonconforming development, encouraging human access, and by destroying vital elements that contribute to the compositional harmony or unity, visual distinctiveness, or diversity of an area.

(c) *Guidelines to minimize impacts.* In addition to the consideration of alternatives in § 230.10(a), Guidelines to minimize impacts as described in § 230.10(d), water dependency in § 230.10(e), and specific measures described in Subparts D, E, and F, where appropriate, specific measures to minimize impacts on aesthetic values include, but are not limited to:

(1) Selecting discharge sites and following discharge procedures that will prevent or minimize any potential damage to the aesthetically pleasing features of the aquatic site, particularly with respect to water quality.

(2) Following procedures that will restore the disturbed area to its natural condition.

(d) *Special determination.* In addition to the determinations required by § 230.20 and the special determinations required by Subparts E and F, where appropriate, special determinations where aesthetic values in aquatic areas may be affected by the discharge of

dredged or fill material include whether the discharge will change or affect the elements of an aquatic or wetland area which contribute to its aesthetic appeal.

§ 230.64 Amenities.

Amenities derived from a natural aquatic ecosystem, including wetlands, include any environmental feature, trait, or character that contributes to the attractiveness of real estate, or to the successful operation of a business serving the public on its premises. Aquatic resources which are unowned or publicly owned may provide amenities to privately owned property in the vicinity.

(a) *Values.* Persons or institutions claiming amenities of the unowned or publicly owned aquatic ecosystem have monetary investments in property, a portion of which can be realized only because of the existence of unowned but accessible aquatic amenities. The added property value attributable to natural amenities varies with the quality, use, and accessibility of aquatic and wetland areas.

(b) *Possible loss of values.* The discharge of dredged or fill material can adversely affect the particular features, traits, or characters of an aquatic area which make it valuable as an amenity to property owners. Dredge or fill activities which degrade water quality, disrupt natural substrate and vegetational characteristics, deny access to the amenities, or result in changes in odor, air quality, or noise levels may reduce the value of an aquatic area as an amenity to private property.

(c) *Guidelines to minimize impacts.* In addition to the consideration of alternatives in § 230.10(a), the Guidelines to minimize impacts as described in § 230.10(d), water dependency in § 230.10(e), and specific measures described in Subparts E and F, where appropriate, specific measures to minimize impacts on amenities include, but are not limited to:

(1) Selecting discharge sites which are of lesser value to nearby property owners as natural aquatic or wetland amenities.

(2) Timing the discharge to avoid interference during seasons or periods when the availability and accessibility of aquatic or wetland amenities are most important.

(3) Following discharge procedures that do not disturb features of the aquatic ecosystem which contribute to the value of an aquatic amenity.

(d) *Special determination.* In addition to the determinations required by § 230.20 and the special determinations required by Subparts E and F, where appropriate, special determinations where aquatic amenities may be affected by discharges of dredged or fill material include whether the discharge will change or affect any feature of an aquatic area which contributes to its value as an amenity to property owners.

Subpart H—Habitat Development and Restoration of Water Bodies

§ 230.65 *Habitat development and restoration of water bodies.*

Habitat development and restoration involves changes in open water and wetlands that minimize adverse effects of proposed changes or that neutralize or reverse the effects of past changes on the ecosystem. Development may produce a new or modified ecological state by displacement of some or all of the existing environmental characteristics. Restoration has the potential to return degraded environments to their former ecological state.

(a) *Values.* Habitat development and restoration can contribute to the maintenance and enhancement of a viable aquatic ecosystem at the discharge site. From an environmental point of view, a project involving discharge of dredged and fill material should be designed and managed to emulate a natural ecosystem. Research, demonstration projects, and full scale implementation have been done in many categories of development and restoration. The U.S. Fish and Wildlife Service has programs to develop and restore habitat. The U.S. Army Engineer Waterways Experiment Station has published guidelines for using dredged material to develop wetland habitat, for establishing marsh vegetation, and for building islands that attract colonies of nesting birds. The EPA has a Clean Lakes program which supplies funds to States and localities to enhance or restore degraded lakes. This may involve dredging nutrient-laden sediments from a lake and ensuring that nutrient inflows to the lake are controlled. Restoration and habitat development techniques can be used to minimize adverse impacts and compensate for destroyed habitat. Restoration and habitat development may also provide secondary benefits such as improved opportunities for outdoor recreation and positive use for dredged materials.

Comment: The development and restoration of viable habitats in water bodies requires planning and construction practices that integrate the new or improved habitat into the existing environment. Planning requires a model or standard constituting a target, the achievement of which is attempted by manipulating design and implementation of the activity. Characteristics of a natural ecosystem in the vicinity of a proposed activity is specified as the model or standard to be used in developing or restoring habitat. Such use of a natural ecosystem is expected to prevent competition among individuals or groups with preconceived ideas of what constitutes acceptable habitat, and ensures that the developed or restored area will be nourished and maintained physically, chemically and biologically by natural processes once established. Some examples of natural ecosystems include, but are not limited to the following: salt marsh, cattail marsh, turtle grass bed, small island, etc.

(b) *Possible loss of values.* Habitat development and restoration, by definition, have environmental enhancement as their initial purpose. Where such projects are not founded on the objectives of maintaining ecosystem function and integrity, some values may be favored to the detriment or loss of others. Human uses of the environmental may not necessarily be considered part of development or restoraton although they may benefit directly from it. The ecosystem affected must be considered in order to achieve the desired result of development and restoration. In the final analysis, selection of the ecosystem to be emulated is of critical importance and a loss of value can occur if the wrong model or an incomplete model is selected. Of equal importance is the planning and management of habitat development and restoration on a case-by-case basis.

(c) *Guidelines to minimize impacts.* In addition to the consideration of alternatives in § 230.10(a) and the guidelines to minimize impact described in § 230.10(d), specific measures to minimize impacts on the aquatic ecosystem by enhancement and restoration projects include but are not limited to:

(1) Selecting the nearest similar natural ecosystem as the model in the implementation of the activity.

Comment: Obviously degraded or significantly less productive habitats may be considered prime candidates for habitat restoration. One viable habitat should not be sacrificed in an attempt to create another, i.e., a productive vegetated shallow water area should not be destroyed in an attempt to create a vegetated wetland in its place.

(2) Using development and restoration techniques that have been demonstrated to be effective in circumstances similar to those under consideration wherever possible.

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(3) Where development and restoration techniques proposed for use have not yet advanced to the pilot demonstration or implementation stage, initiate their use on a small scale to allow corrective action if unanticipated adverse impacts occur.

(4) Where Federal funds are spent to clean up waters of the U.S. through dredging, scientifically defensible levels of concentration of pollutants in the return discharge shall be agreed upon with the funding authority in addition to any applicable water quality standards in order to maintain the desired improved water quality.

(5) When a significant ecological change in the aquatic environment is proposed by the discharge of dredged or fill material, the permitting authority should consider the ecosystem that will be lost as well as the environmental benefits of the new system.

Subpart I—General Processes and Procedures

§ 230.70 Advanced identification of dredged material disposal areas.

(a) Consistent with these guidelines and after consultation with EPA, permitting authorities may identify areas which will be considered as:

(1) Possible future disposal sites, including existing disposal sites and non-sensitive areas.

(2) Areas which will not be available for disposal site specification.

(3) Subject to emergency action to limit activities that could cause adverse cumulative or secondary effects to the aquatic ecosystem (see § 230.72).

(b) The identification of any area as a possible future disposal site shall not be deemed to constitute a permit for the discharge of dredged or fill material within such an area or a specification of discharge site, but may be used in evaluating individual or general permit applications.

(c) The appropriate public shall be notified of proposed identification of such areas. A record of areas so identified shall be maintained.

(d) To provide the basis for advanced identification of disposal areas, areas not available for disposal, and areas subject to emergency action, water bodies should be assessed to determine those areas which are of critical ecological concern, those which are of environmental concern those in which cumulative or secondary impacts are predictable, and non-sensitive areas. Those in which cumulative or secondary impacts are predictable, and nonsensitive areas. To facilitate this analysis, water resources management data should be assembled including such data as may be available form the public, other Federal and State agencies, and information from approved Coastal Zone Management Programs and River Basin Plans.

(e) The permitting authority shall maintain a record of the identified areas and a written statement of the basis for identification.

§ 230.71 General or categorical permits.

(a) *Conditions for the issuance of general permits.* General permits for a category of activities involving the discharge of dredged or fill material comply with the guidelines if it is determined by the permitting authority, after evaluation through the process outlined in the Guidelines, that:

(1) The activities in such category are similar in nature and similar in their impact upon water quality and the aquatic and wetland environment;

(2) The activities in such category will have only minimal adverse effects when performed separately; and

(3) The activities in such category will have only minimal cumulative adverse effects on water quality and the aquatic and wetland environment.

(b) *Evaluation process.* To reach the determinations required in paragraph (a) of this section, the permitting authority shall set forth in writing an evaluation of the potential individual and cumulative impacts of the category of activities to be regulated under the general permit.

(1) This evaluation shall be based upon consideration of the prohibitions listed in § 230.10(b) and the factors listed in § 230.10(c), and shall include documented information supporting each factual determination in § 230.20 of the Guidelines;

Comment: General permits are an important means of protecting the open water and wetland environments. Therefore, insofar as possible, general permits should be subjected to a rigorous development and review concerning impact on open water and wetland environments as individual permits. When a general permit is issued, the Guidelines will have been considered in depth, and measures to protect the environment already will have been incorporated. Therefore, when the users of a general permit comply with the conditions in that permit they reasonably can expect to have complied with the pertinent aspects of these Guidelines.

(2) The evaluation shall include a precise description of the activities to be permitted under the general permit, explaining why they are sufficiently similar in nature and in environmental impact to warrant regulation under a single general permit based on Subparts D–G of the Guidelines. Allowable differences between activities which will be regulated under the same general permit shall be specified. In addition, activities otherwise similar in nature may differ in environmental impact due to their location in or near ecologically sensitive areas, areas with unique chemical or physical characteristics or concerns (e.g., areas containing concentrations of toxic substances), and areas regulated for specific human uses or by specific land or water management plans (e.g., areas regulated under an approved Coastal Zone Management Plan). For these reasons, if there are specific geographic areas and water bodies within the purview of a proposed general permit, which are more appropriately regulated by individual permit due to the consideration cited in this paragraph, they shall be clearly delineated in the assessment and identified in the permit;

(3) To predict cumulative effects, the assessment shall include the number of individual discharge activities likely to be regulated under a general permit until its expiration, including repetitions of individual discharge activities.

§ 230.72 Cumulative and secondary impacts on the aquatic ecosystem.

(a) Cumulative impacts are changes in an aquatic ecosystem that are attributable to the collective effect of a number of individual discharges of dredged or fill material. Secondary impacts are changes in the aquatic ecosystem that are attributable to the purpose of the discharge of a dredged material disposal site or a fill, and not to the actual placement or dredged or fill material. Some examples of secondary impacts on aquatic ecosystem are fluctuating water levels in an impoundment and downstream associated with operation of a dam, septic tank leaching and surface runoff from residential or commercial developments on fill, leachate and runoff from a sanitary landfill located in waters of the U.S., and development of real estate improvements on a dredged material disposal site in a wetland in a manner that results in pollution of adjacent wetlands or other waters through runoff or other effects.

(b) Both cumulative and secondary impacts on the aquatic ecosystem which could not occur without the discharge of dredged or fill material in waters of the U.S., can have adverse effect on the chemical, phyiscal, and biological integrity of the Nation's waters. Cumulative and secondary effects attributable to the discharge of dredged or fill material in waters of the U.S.

should be predicted to a reasonable and practical extent.

(c) Information about cumulative effects on aquatic ecosystems shall be taken into consideration by section 404 *permitting authorities. Information about* secondary impacts on aquatic ecosystems shall be considered prior to the time final section 404 action is taken by permitting authorities, and when actions under any other section of the Act such as 301, 302, or under any other Acts are taken that involve section 404. Activities on fast land created by the discharged of dredged or fill material in waters of the U.S. are considered to be in waters of the U.S. for purposes of these Guidelines.

(d) The permitting authority or other responsible Federal or State authority shall collect information and solicit information from other sources about cumulative and secondary impacts on the aquatic ecosystem. This information *shall be considered and documented* at the time of inter- and intra-agency reviews leading to a decision concerning a section 404 activity, section 404 Public Notices and Public Hearings, and EIS preparation involving section 404 considerations.

Dated: September 5, 1979.

Douglas M. Costle,

Administrator.

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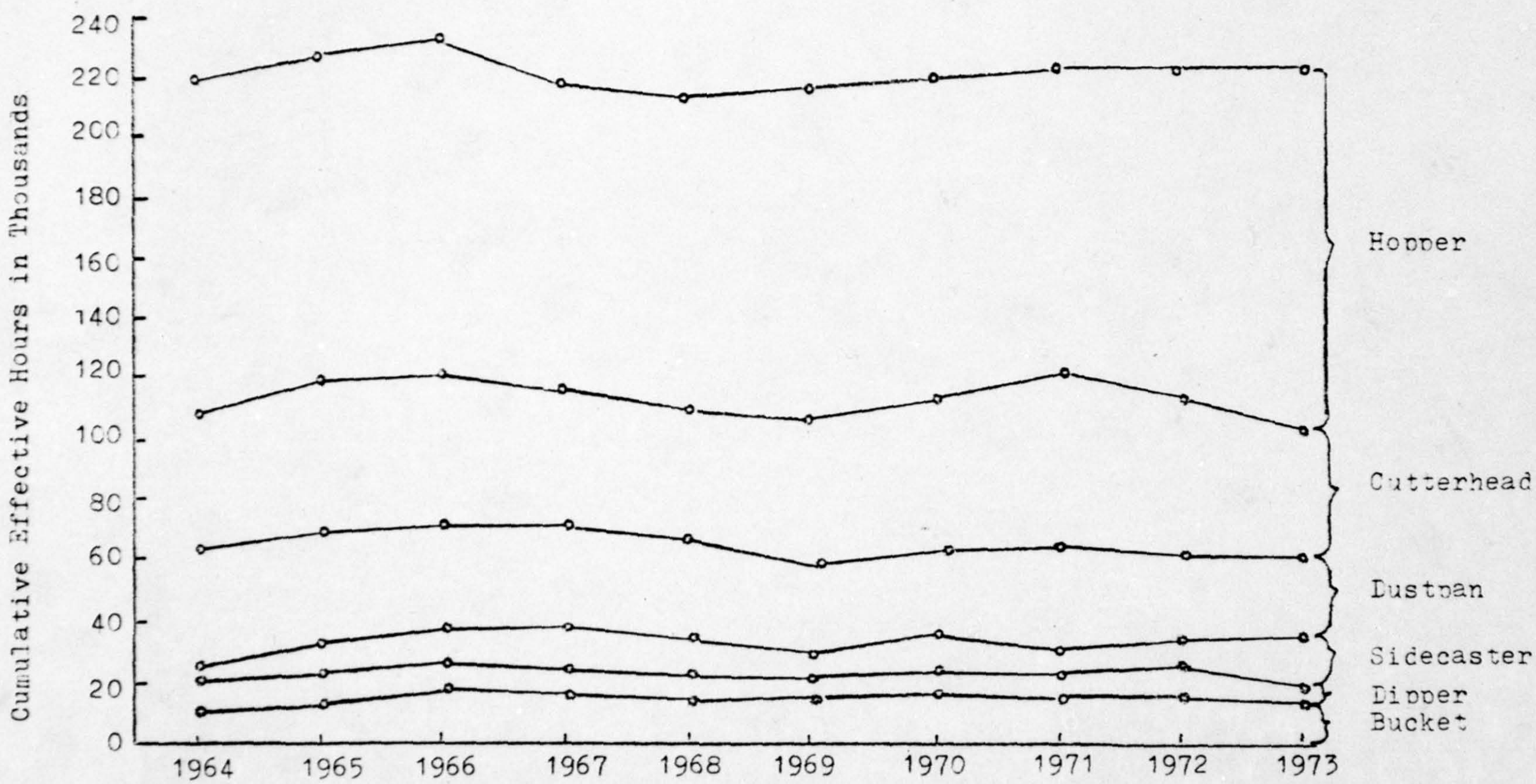
UTILIZATION OF CORPS OF ENGINEER DREDGES

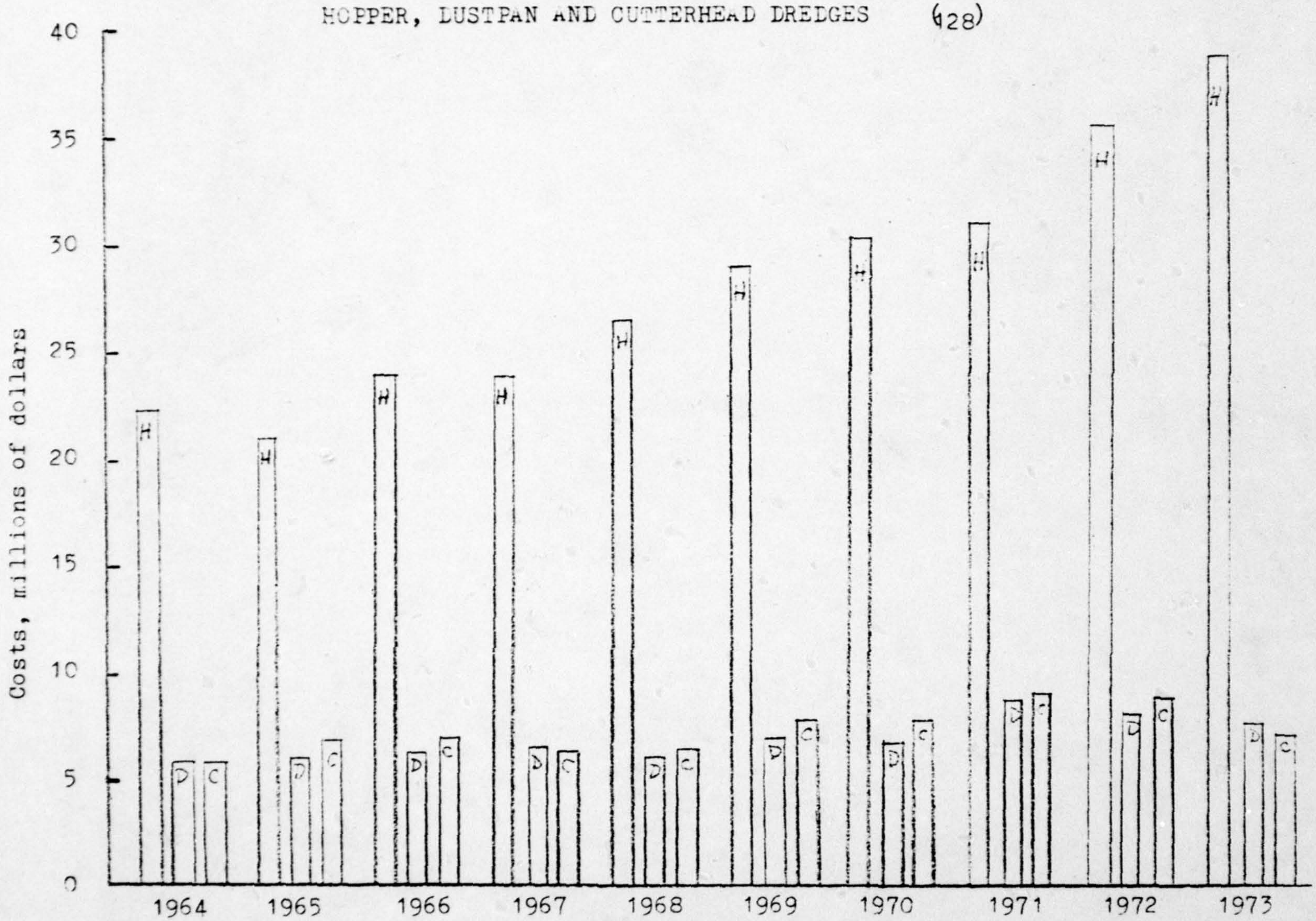
BY TYPE OF DREDGE, 1964-1973 (127)



APPENDIX J

NATIONWIDE DREDGING COSTS BY CORPS OF ENGINEER

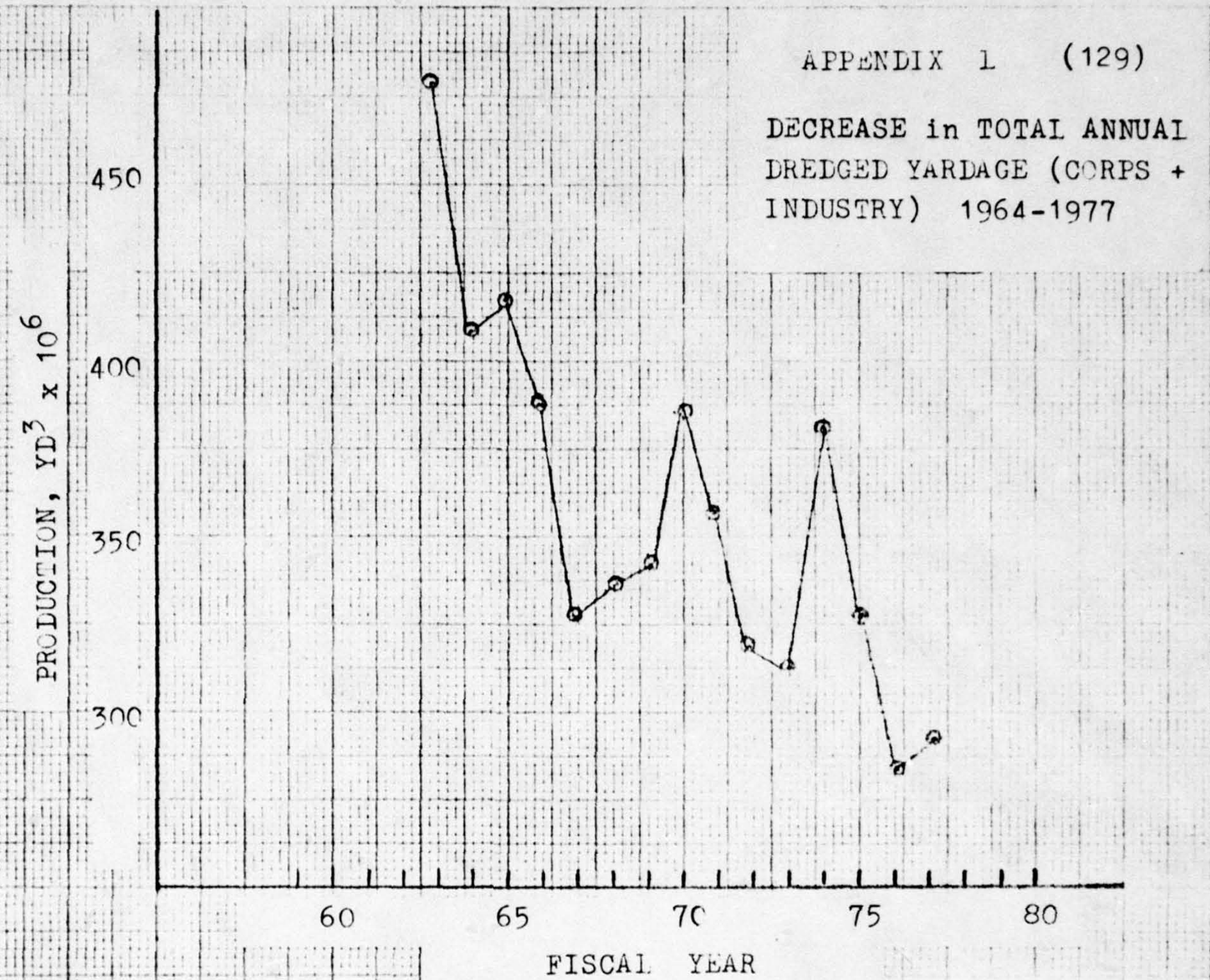
HOPPER, LUSTPAN AND CUTTERHEAD DREDGES (28)



APPENDIX K

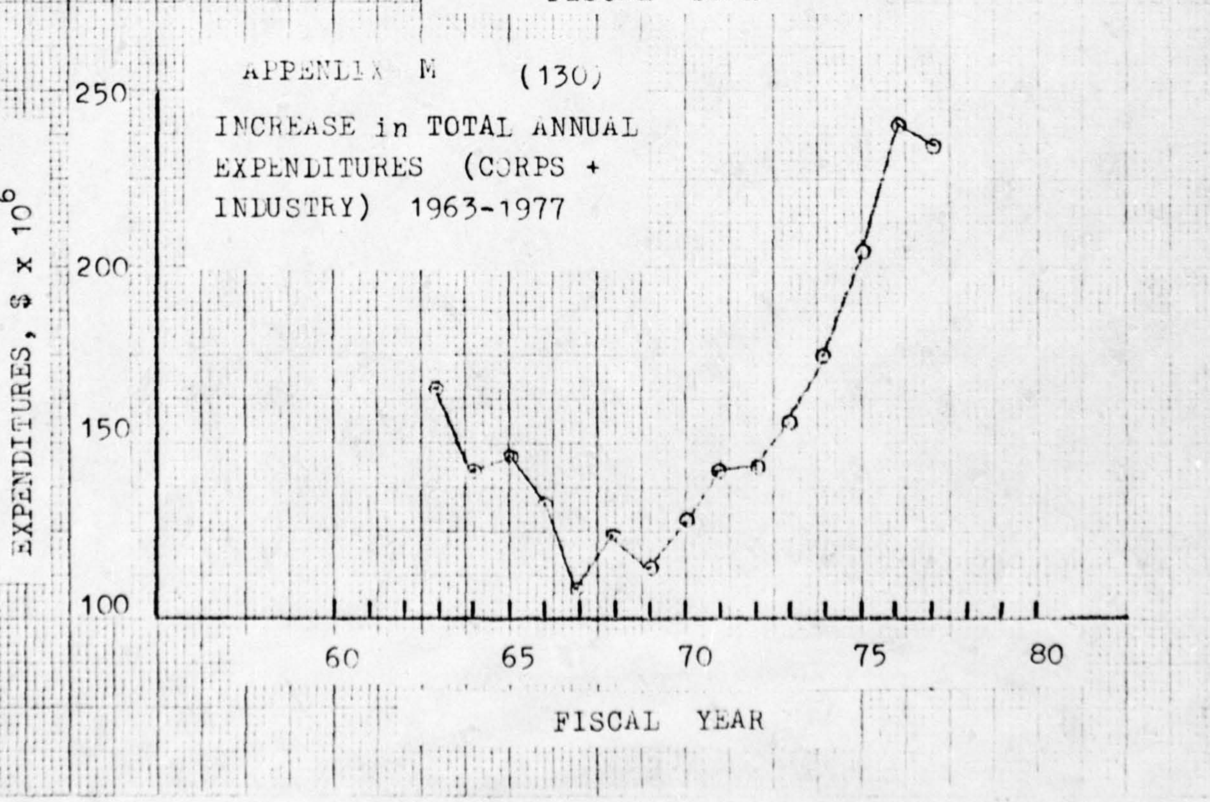
APPENDIX L (129)

DECREASE in TOTAL ANNUAL DREDGED YARDAGE (CORPS + INDUSTRY) 1964-1977



APPENDIX M (130)

INCREASE in TOTAL ANNUAL EXPENDITURES (CORPS + INDUSTRY) 1963-1977

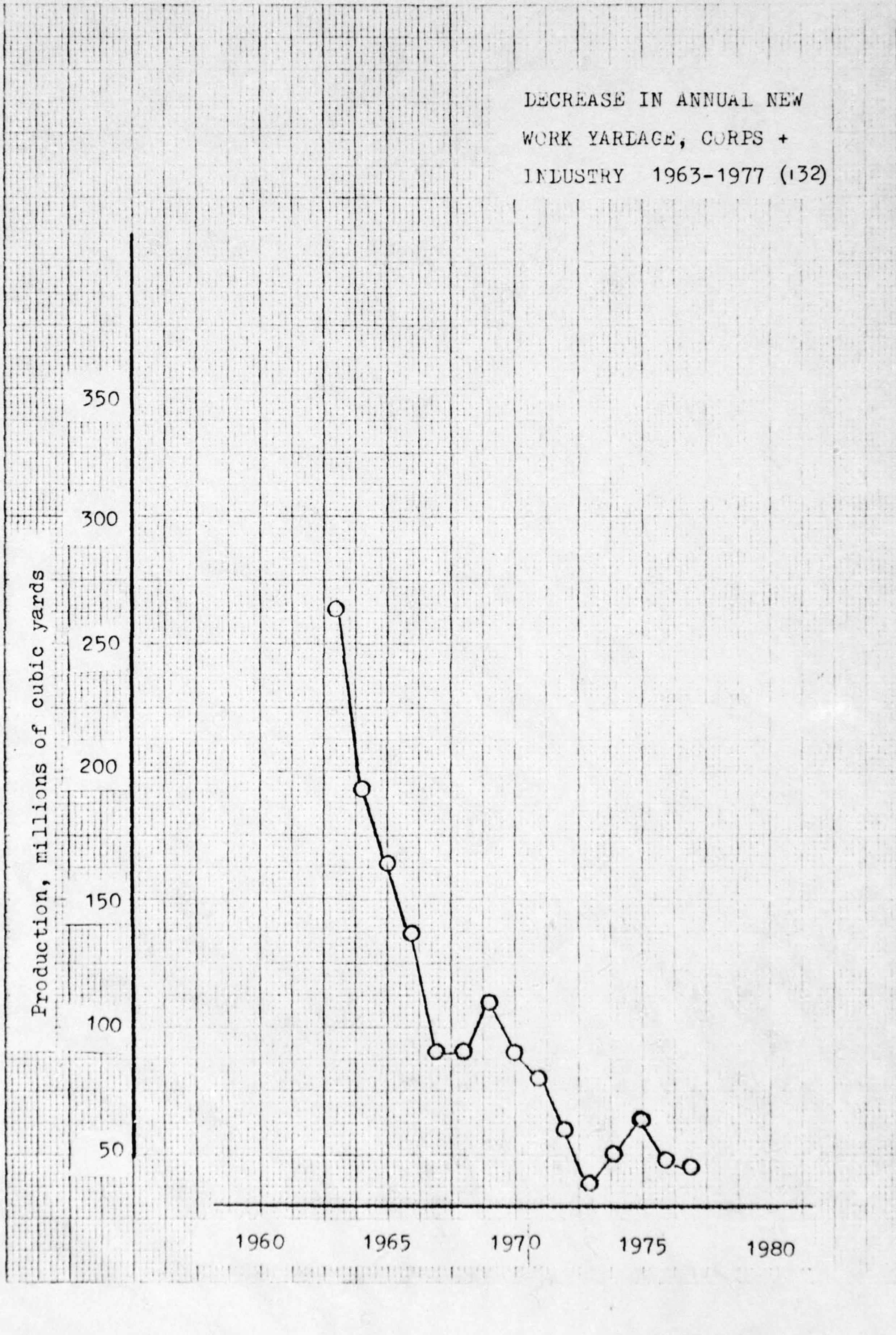


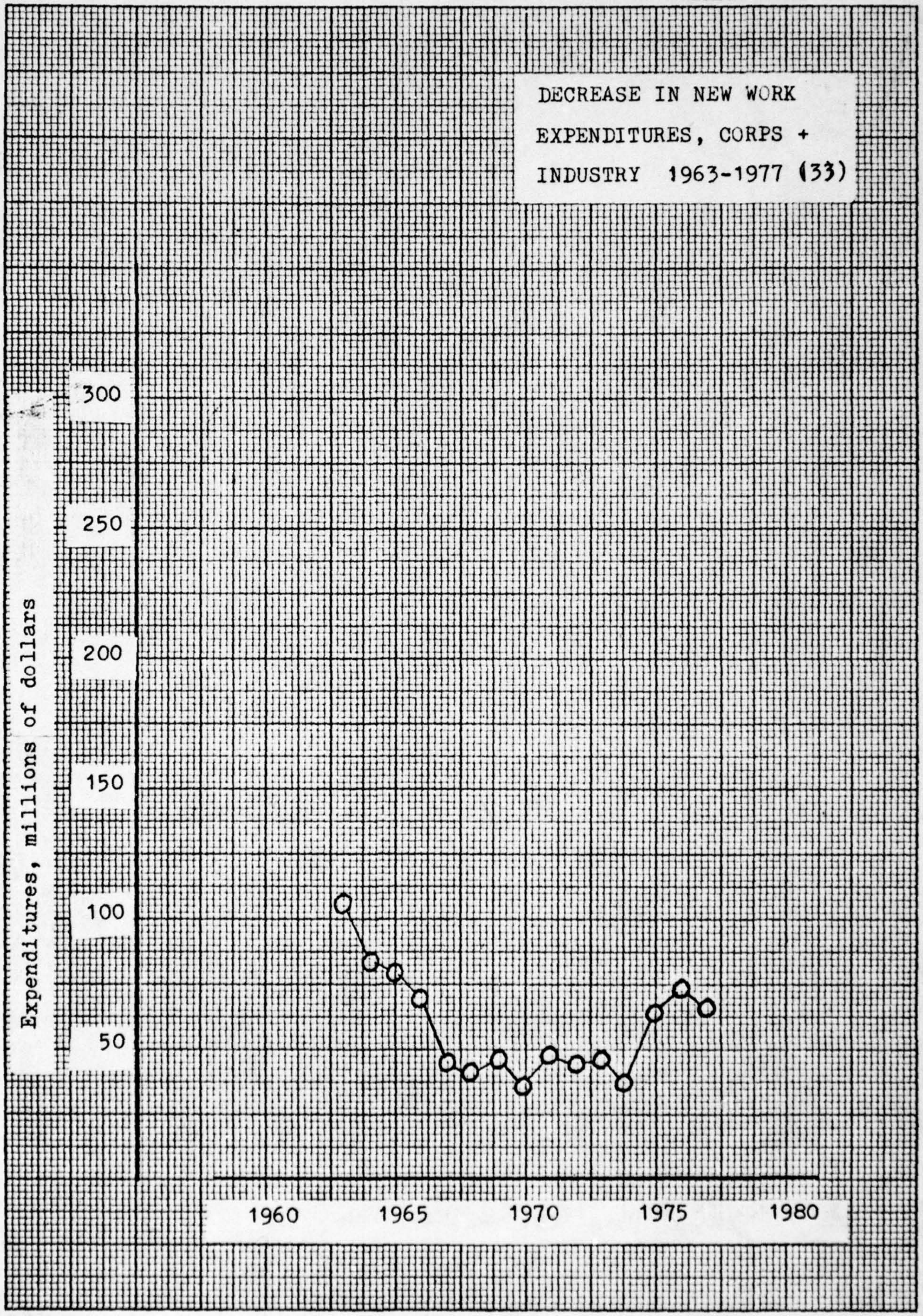
AVERAGE UNIT DREDGING COSTS

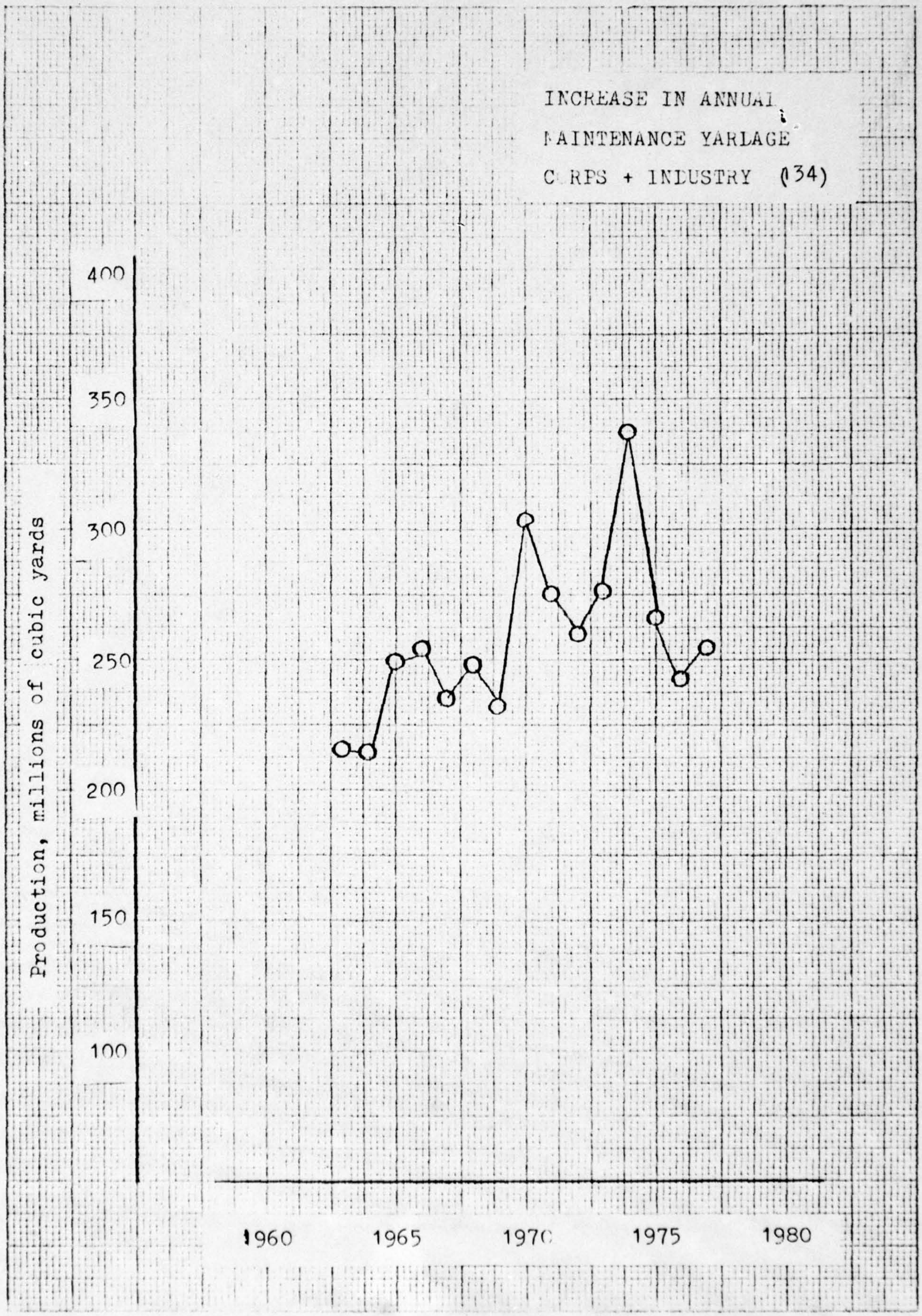
(CORPS and Industry, 1963-1977) (131)

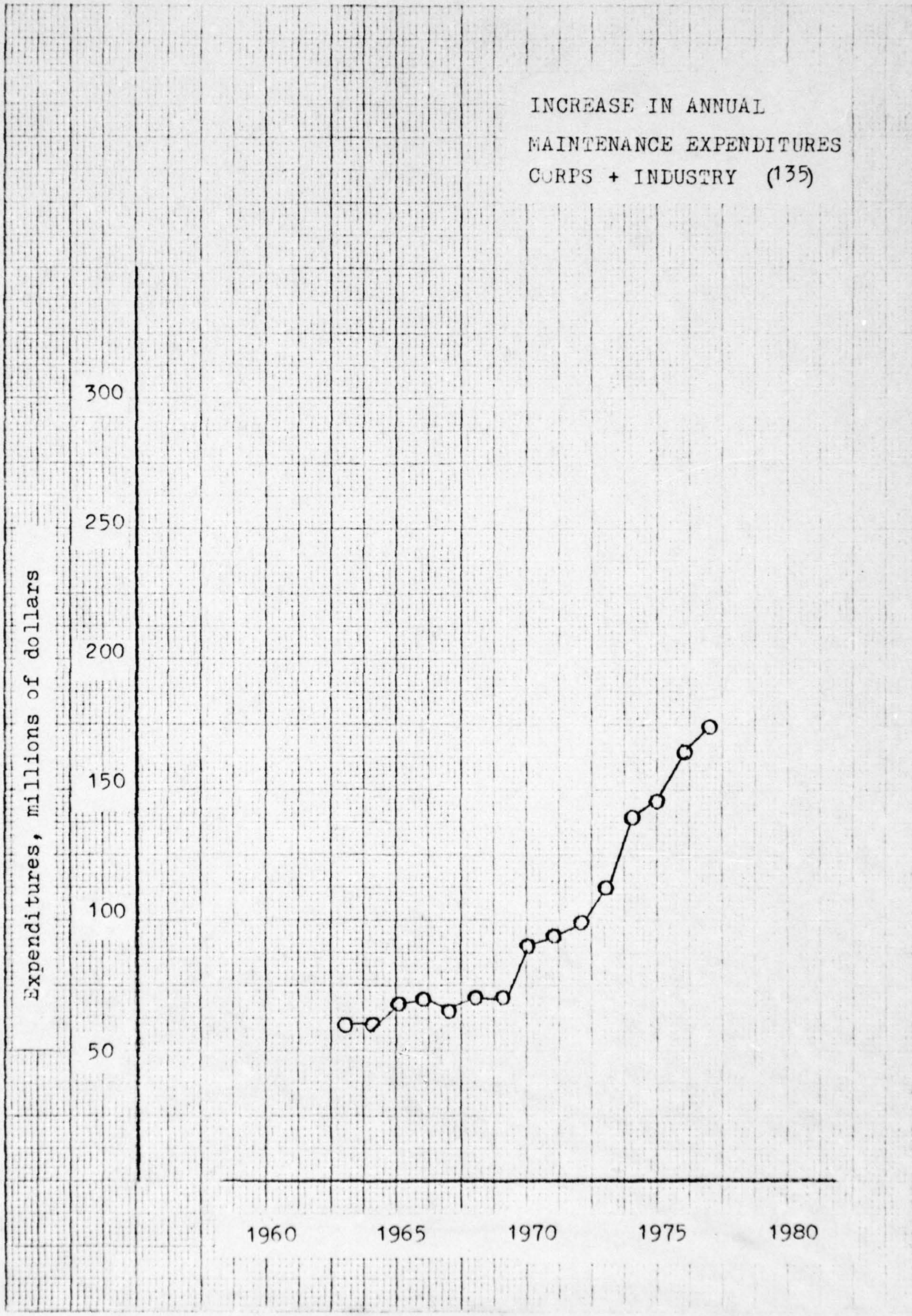
Fiscal Year	Total Cost $millions	Total cubic yards, millions	Average unit cost, cents/yd^3
1963	166	480	34.6
1964	142	409	34.7
1965	148	416	35.6
1966	137	390	35.1
1967	110	327	33.6
1968	112	338	33.1
1969	115	342	33.6
1970	128	392	32.7
1971	141	357	39.5
1972	141	315	44.8
1973	157	312	50.3
1974	176	386	45.6
1975	207	332	62.3
1976	240	287	83.6
1977	237	298	79.5

APPENDIX N

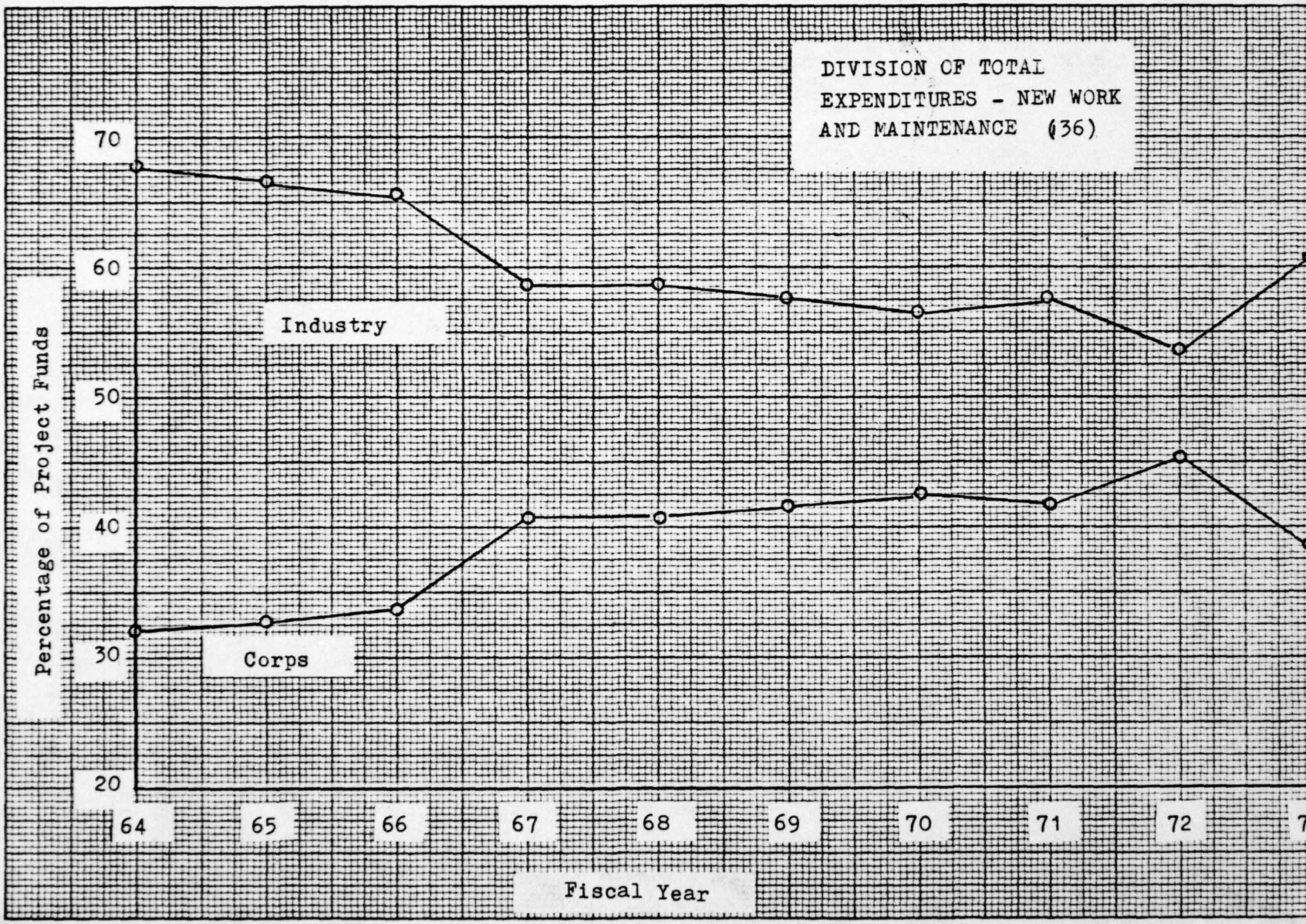

DECREASE IN ANNUAL NEW
WORK YARDAGE, CORPS +
INDUSTRY 1963-1977 (132)
Production, millions of cubic yards
350
300
250
200
150
100
50
1960
1965
1970
1975
1980


DECREASE IN NEW WORK
EXPENDITURES, CORPS +
INDUSTRY 1963-1977 (33)
Expenditures, millions of dollars
300
250
200
150
100
50
1960
1965
1970
1975
1980


INCREASE IN ANNUAL
MAINTENANCE YARDAGE
CORPS + INDUSTRY (134)
Production, millions of cubic yards
400
350
300
250
200
150
100
1960
1965
1970
1975
1980


INCREASE IN ANNUAL
MAINTENANCE EXPENDITURES
CORPS + INDUSTRY (135)
Expenditures, millions of dollars
300
250
200
150
100
50
1960
1965
1970
1975
1980

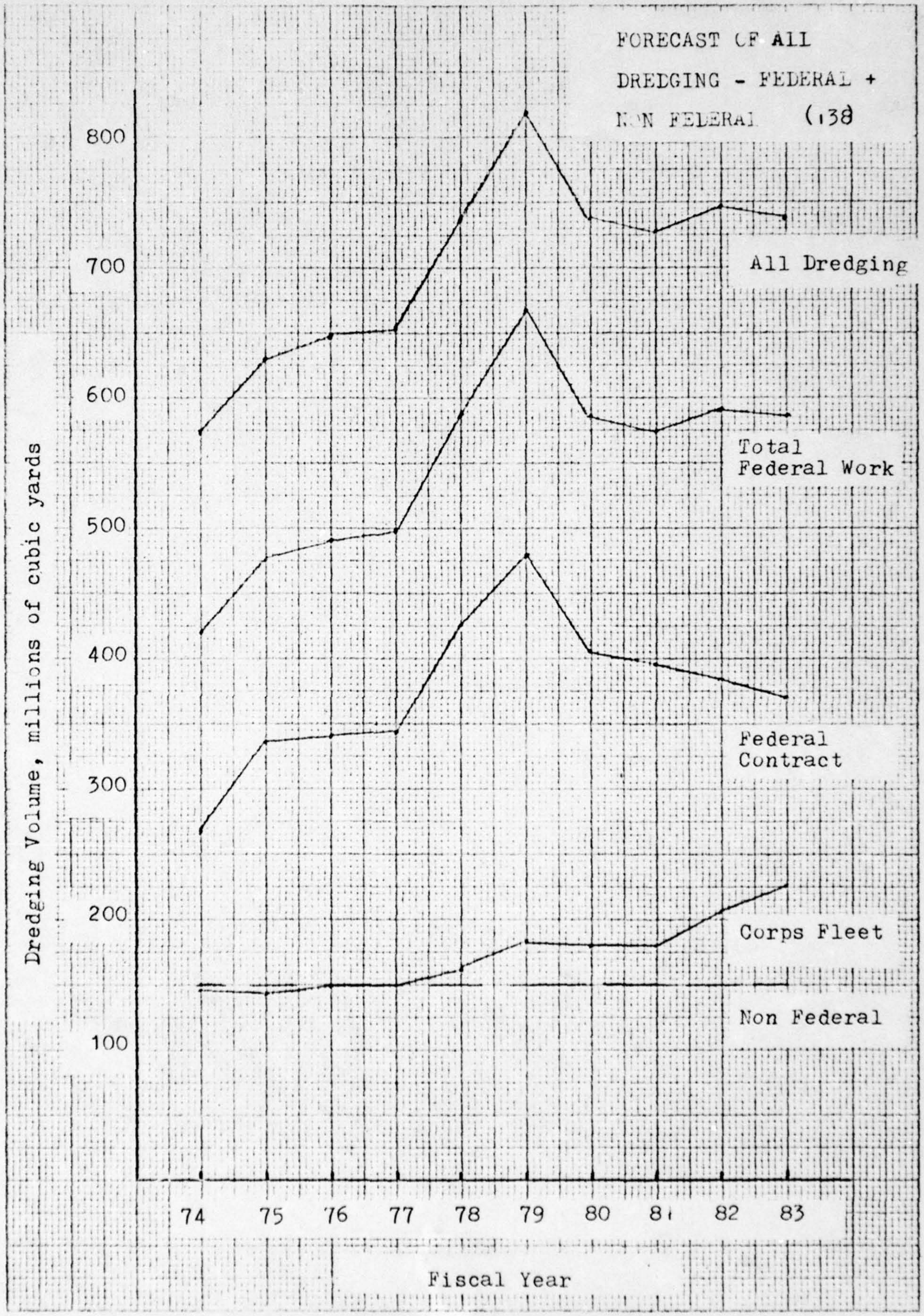
APPENDIX S

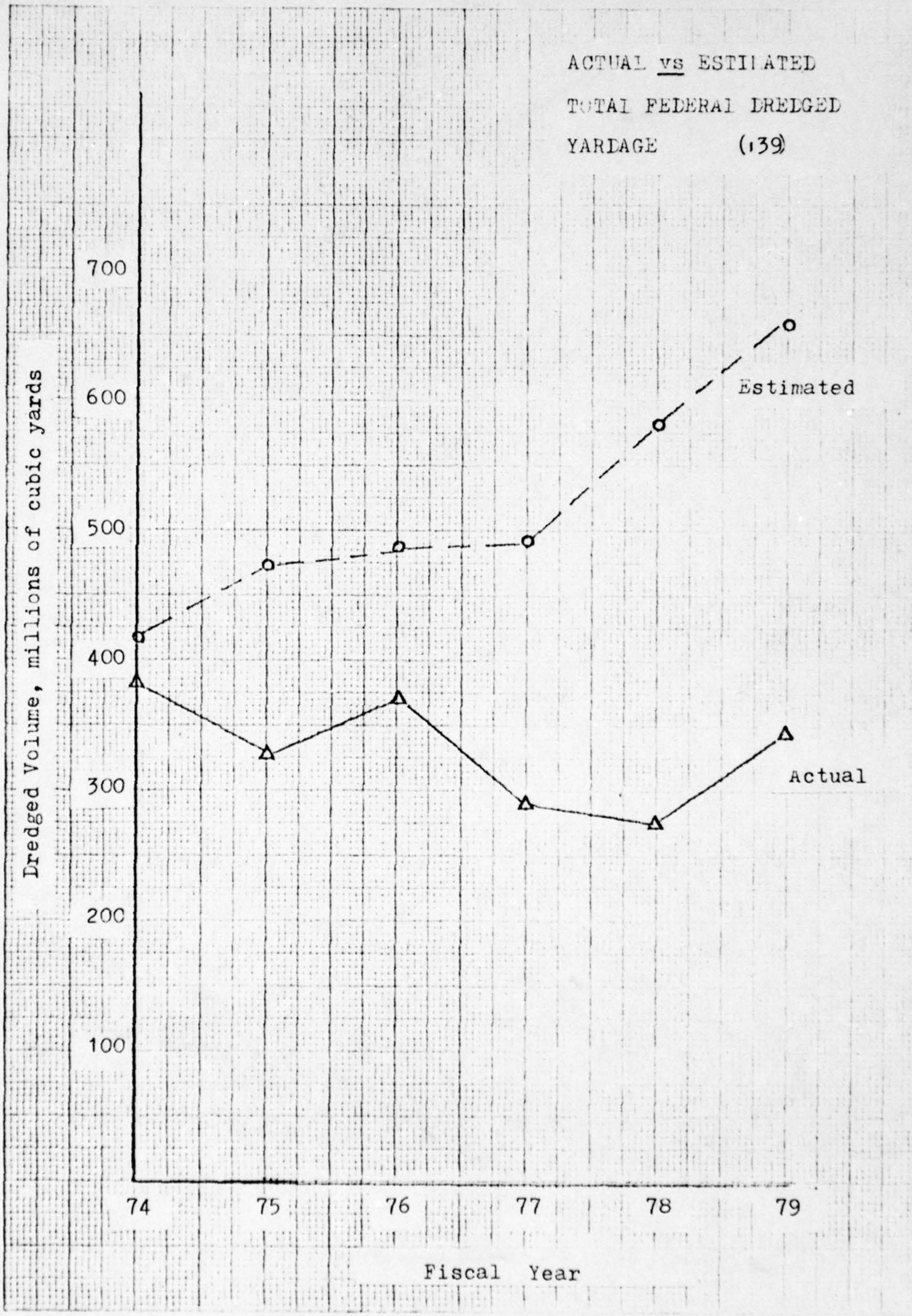

DIVISION OF TOTAL
EXPENDITURES - NEW WORK
AND MAINTENANCE (36)
Percentage of Project Funds
70
60
50
40
30
20
Industry
Corps
64
65
66
67
68
69
70
71
72
73
Fiscal Year

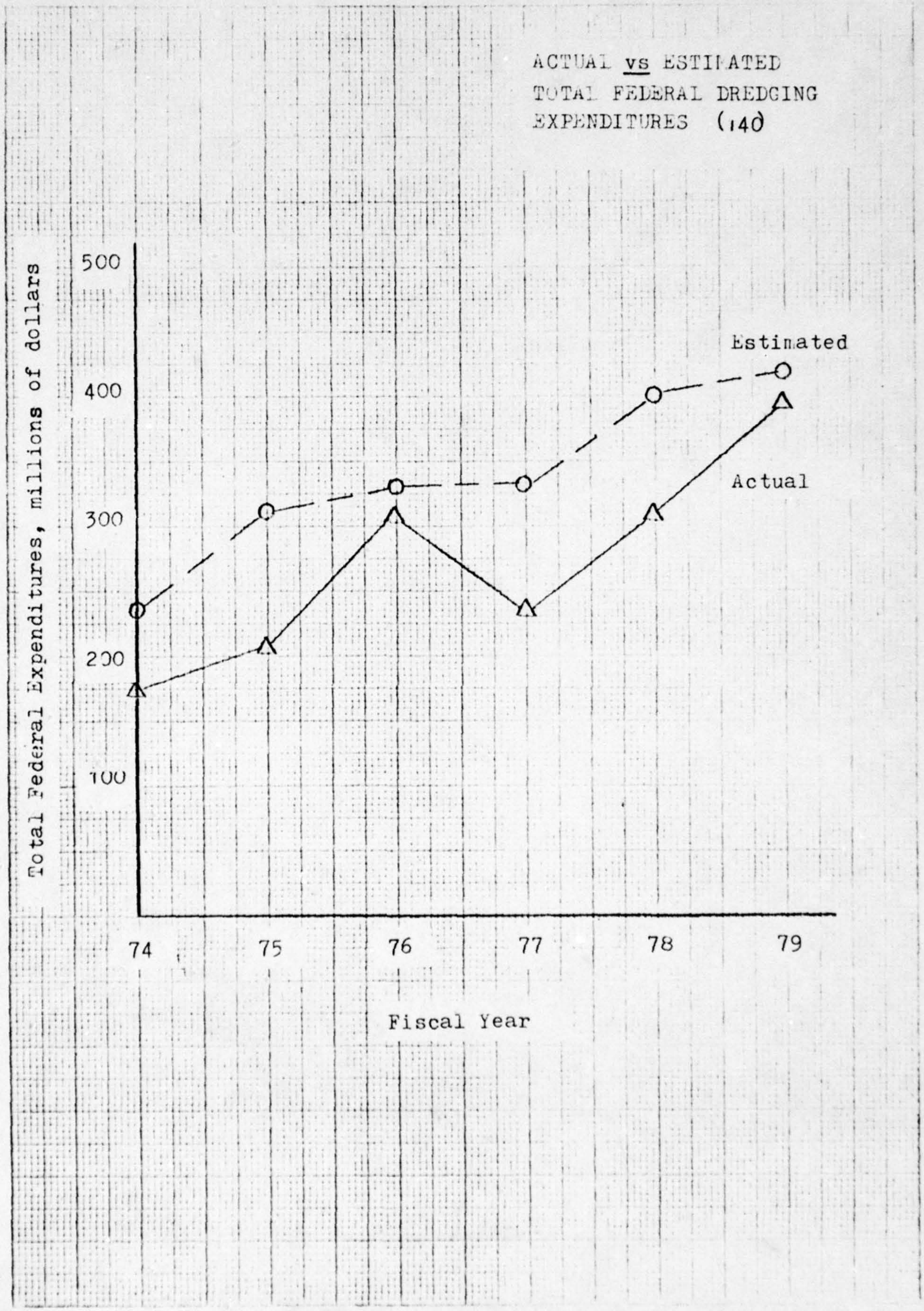
SUMMARY OF ACTIVITIES
CORPS & INDUSTRY
DOLLARS AND YARDAGE(millions) (137)

FISCAL YEAR	CORPS						INDUSTRY						CORPS + INDUSTRY					
	DOLLARS			YARDS			DOLLARS			YARDS			DOLLARS			YARDS		
	Maint	NW	TOT	Maint	NW	TOT	Maint	NW	TOT	Maint	NW	TOT	Maint	NW	TOT	Maint	NW	TOT
1963	27	8	35	137	25	162	32	99	131	80	238	318	59	107	166	217	263	480
1964est	30	6	36	108	18	126	29	77	106	109	174	283	59	83	142	217	192	409
1965est	34	7	41	123	20	143	34	73	107	127	146	273	68	80	148	250	166	416
1966est	34	8	42	123	22	145	35	60	95	131	114	245	69	68	137	253	137	390
1967	36	5	41	130	14	144	28	41	69	105	78	183	64	46	110	235	92	327
1968	36	7	43	116	22	138	34	35	69	133	67	200	70	42	112	249	89	338
1969	39	5	44	141	14	155	31	40	71	92	95	187	70	45	115	233	109	342
1970	43	6	49	143	13	156	49	30	79	160	76	236	92	36	128	303	89	392
1971	46	6	52	145	13	158	47	42	89	133	66	199	93	48	141	278	79	357
1972	49	6	55	145	13	158	49	37	86	111	46	157	98	43	141	256	59	315
1973	50	6	56	145	8	153	62	39	101	131	28	159	112	45	157	276	36	312
1974	63	7	70	183	7	190	77	29	106	155	41	196	140	36	176	338	48	386
1975	75	7	82	157	7	164	71	54	125	110	58	168	146	61	207	267	65	332
1976	81	3	84	123	2	125	86	70	156	117	45	162	167	73	240	240	47	287
1976"T"	26	2	28	42	2	44	23	15	38	37	8	45	49	17	66	79	10	89
1977	85	1	86	127	1	128	90	61	151	126	44	170	175	62	237	253	45	298
1978	90	2	92	92	2	94	124	91	215	118	68	186	214	93	307	210	70	280
1979est	97	7	104	100	1	101	168	123	291	178	71	249	265	130	395	278	72	350

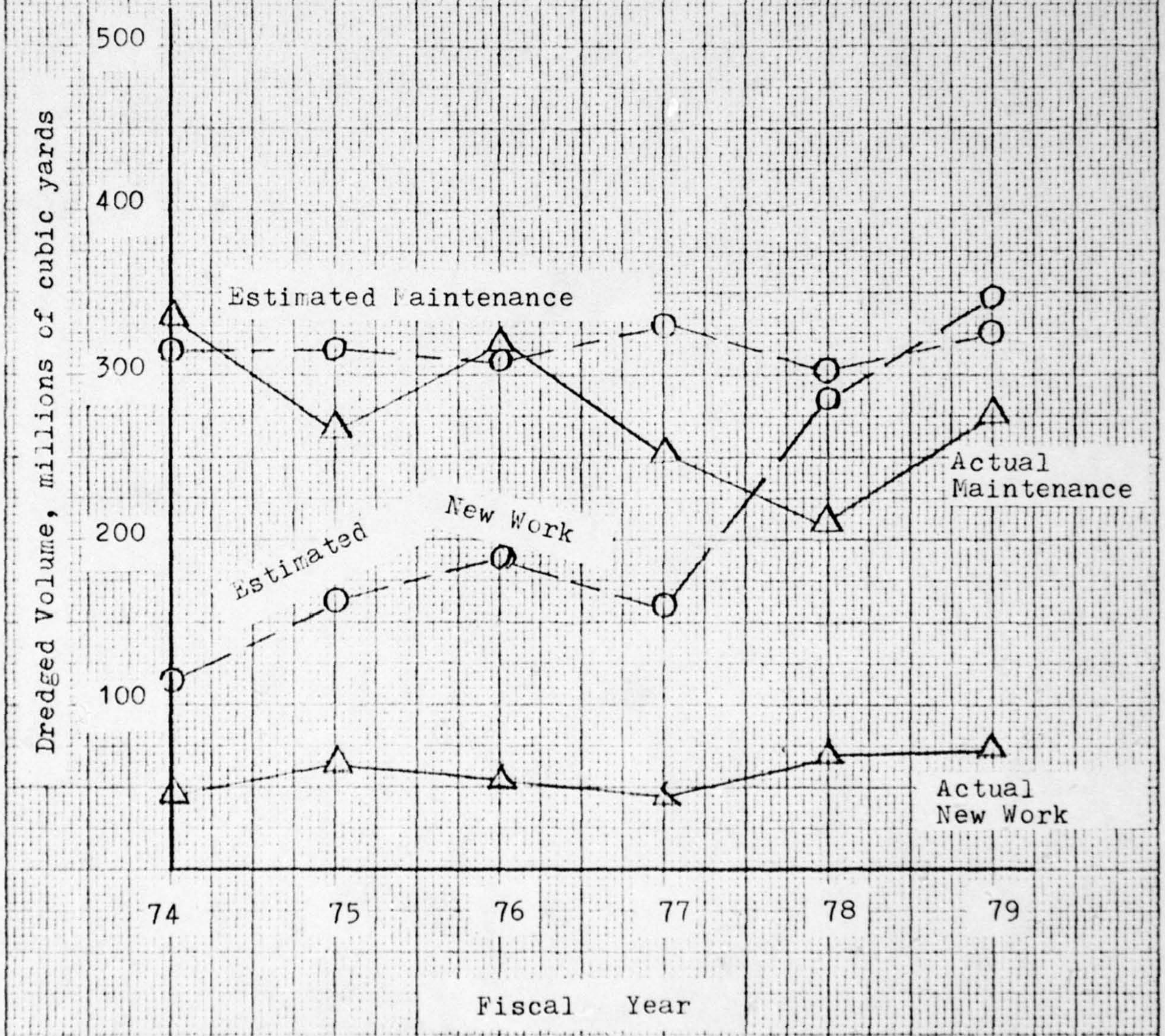
APPENDIX T

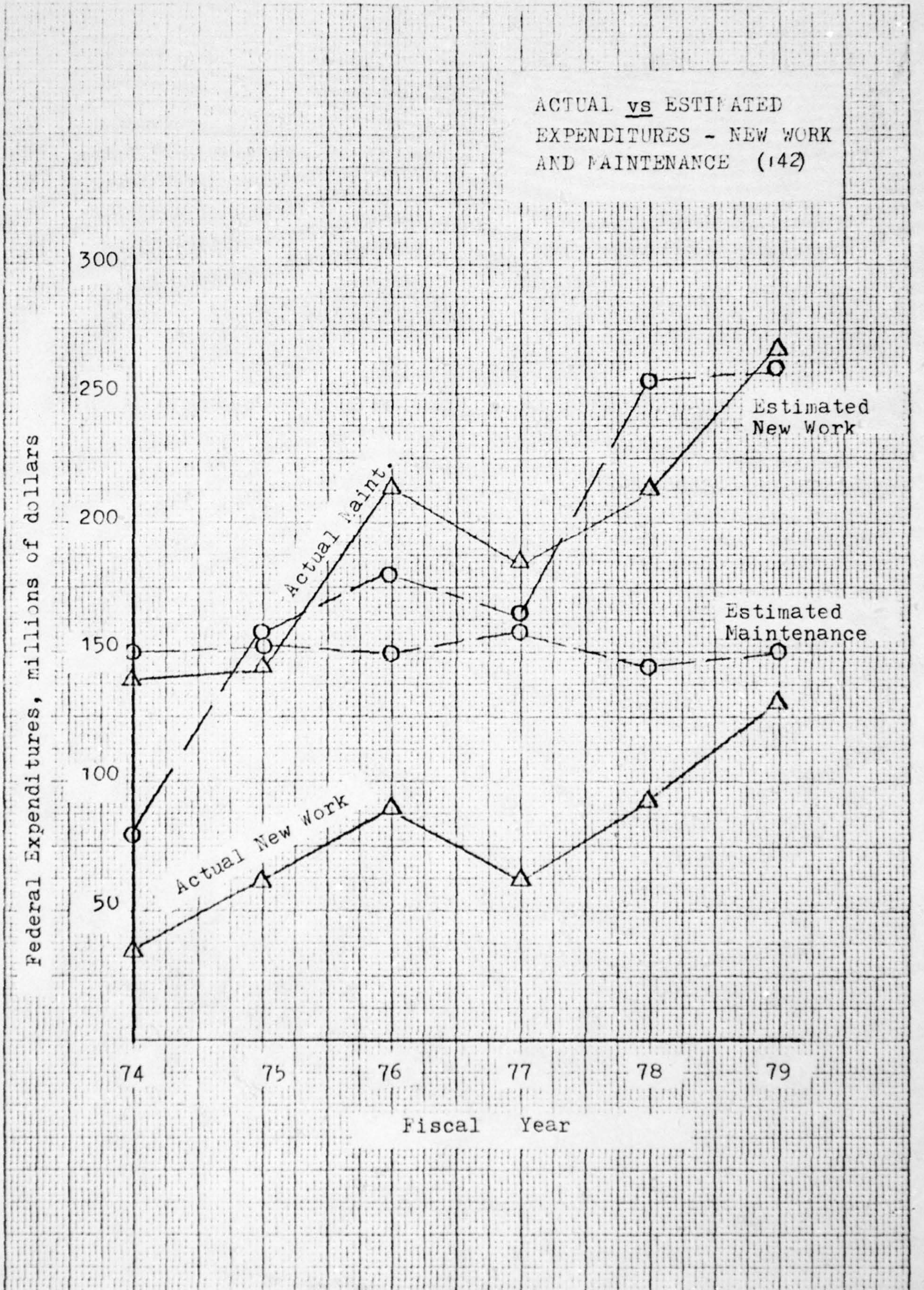

FORECAST OF All
DREDGING - FEDERAL +
NON FEDERAL (138)
800
700
600
500
400
300
200
100
Dredging Volume, millions of cubic yards
All Dredging
Total
Federal Work
Federal
Contract
Corps Fleet
Non Federal
74
75
76
77
78
79
80
81
82
83
Fiscal Year


ACTUAL vs ESTIMATED
TOTAL FEDERAL DREDGED
YARDAGE (139)
Dredged Volume, millions of cubic yards
700
600
500
400
300
200
100
Estimated
Actual
74
75
76
77
78
79
Fiscal Year


ACTUAL vs ESTIMATED
TOTAL FEDERAL DREDGING
EXPENDITURES (140)
Total Federal Expenditures, millions of dollars
500
400
300
200
100
Estimated
Actual
74
75
76
77
78
79
Fiscal Year

ACTUAL vs ESTIMATED
DREDGED QUANTITIES -
NEW WORK & MAINTENANCE
(41)




ACTUAL vs ESTIMATED EXPENDITURES - NEW WORK AND MAINTENANCE (142)
Federal Expenditures, millions of dollars
300
250
200
150
100
50
Actual Maint.
Estimated New Work
Estimated Maintenance
Actual New Work
74
75
76
77
78
79
Fiscal Year

RIVERS AND HARBORS, IMPROVEMENTS

99-139 O - 78 (34

APPENDIX Z

Public Law 95-269
95th Congress

An Act

Apr. 26, 1978
[H.R. 7744]

To amend the Acts of August 11, 1888, and March 2, 1919, pertaining to carrying out projects for improvements of rivers and harbors by contract or otherwise, and for other purposes.

Rivers and harbors, improvements

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That section 3 of the Act of August 11, 1888 (25 Stat. 423; 33 U.S.C. 622), is amended to read as follows:

"Sec. 3. (a) The Secretary of the Army, acting through the Chief of Engineers (hereinafter referred to as the 'Secretary'), in carrying out projects for improvement of rivers and harbors (other than surveys, estimates, and gagings) shall, by contract or otherwise, carry out such work in the manner most economical and advantageous to the United States. The Secretary shall have dredging and related work done by contract if he determines private industry has the capability to do such work and it can be done at reasonable prices and in a timely manner. During the four-year period which begins on the date of enactment of this subsection, the Secretary may limit the application of the second sentence of this subsection for work for which the federally owned fleet is available to achieve an orderly transition to full implementation of this subsection.

"(b) As private industry reasonably demonstrates its capability under subsection (a) to perform the work done by the federally owned fleet, at reasonable prices and in a timely manner, the federally owned fleet shall be reduced in an orderly manner, as determined by the Secretary, by retirement of plant. To carry out emergency and national defense work the Secretary shall retain only the minimum federally owned fleet capable of performing such work and he may exempt from the provisions of this section such amount of work as he determines to be reasonably necessary to keep such fleet fully operational, as determined by the Secretary, after the minimum fleet requirements have been determined. Notwithstanding the preceding sentence, in carrying out the reduction of the federally owned fleet, the Secretary may retain so much of the federally owned fleet as he determines necessary, for so long as he determines necessary, to insure the capability of the Federal Government and private industry together to carry out projects for improvements of rivers and harbors. For the purpose of making the determination required by the preceding sentence the Secretary shall not exempt any work from the requirements of this section. The minimum federally owned fleet shall be maintained to technologically modern and efficient standards, including replacement as necessary. The Secretary is authorized and directed to undertake a study to determine the minimum federally owned fleet required to perform emergency and national defense work. The study, which shall be submitted to Congress within two years after enactment of this subsection, shall also include preservation of employee rights of persons presently employed on the existing federally owned fleet.".

Study.

Submittal to Congress.

SEC. 2. Section 8 of the Act of March 2, 1919 (40 Stat. 1290; 33 U.S.C. 624) is amended to read as follows:

"SEC. 8. (a) No works of river and harbor improvement shall be done by private contract—

"(1) if the Secretary of the Army, acting through the Chief of Engineers, determines that Government plant is reasonably available to perform the subject work and the contract price for doing the work is more than 25 per centum in excess of the estimated comparable cost of doing the work by Government plant; or

"(2) in any other circumstance where the Secretary of the Army, acting through the Chief of Engineers, determines that the contract price is more than 25 per centum in excess of what he determines to be a fair and reasonable estimated cost of a well-equipped contractor doing the work.

"(b) In estimating the comparable cost of doing the work under subsection (a)(1) by Government plant the Secretary of the Army, acting through the Chief of Engineers shall, in addition to the cost of labor and materials, take into account proper charges for depreciation of plant, all supervising and overhead expenses, interest on the capital invested in the Government plant (but the rate of interest shall not exceed the maximum prevailing rate being paid by the United States on current issues of bonds or other evidences of indebtedness) and such other Government expenses and charges as the Chief of Engineers determines to be appropriate.

"(c) In determining a fair and reasonable estimated cost of doing work by private contract under subsection (a)(2), the Secretary of the Army, acting through the Chief of Engineers, shall, in addition to the cost of labor and materials, take into account proper charges for depreciation of plant, all expenses for supervision, overhead, workmen's compensation, general liability insurance, taxes (State and local), interest on capital invested in plant, and such other expenses and charges the Secretary of the Army, acting through the Chief of Engineers, determines to be appropriate.".

Approved April 26, 1978.

LEGISLATIVE HISTORY:

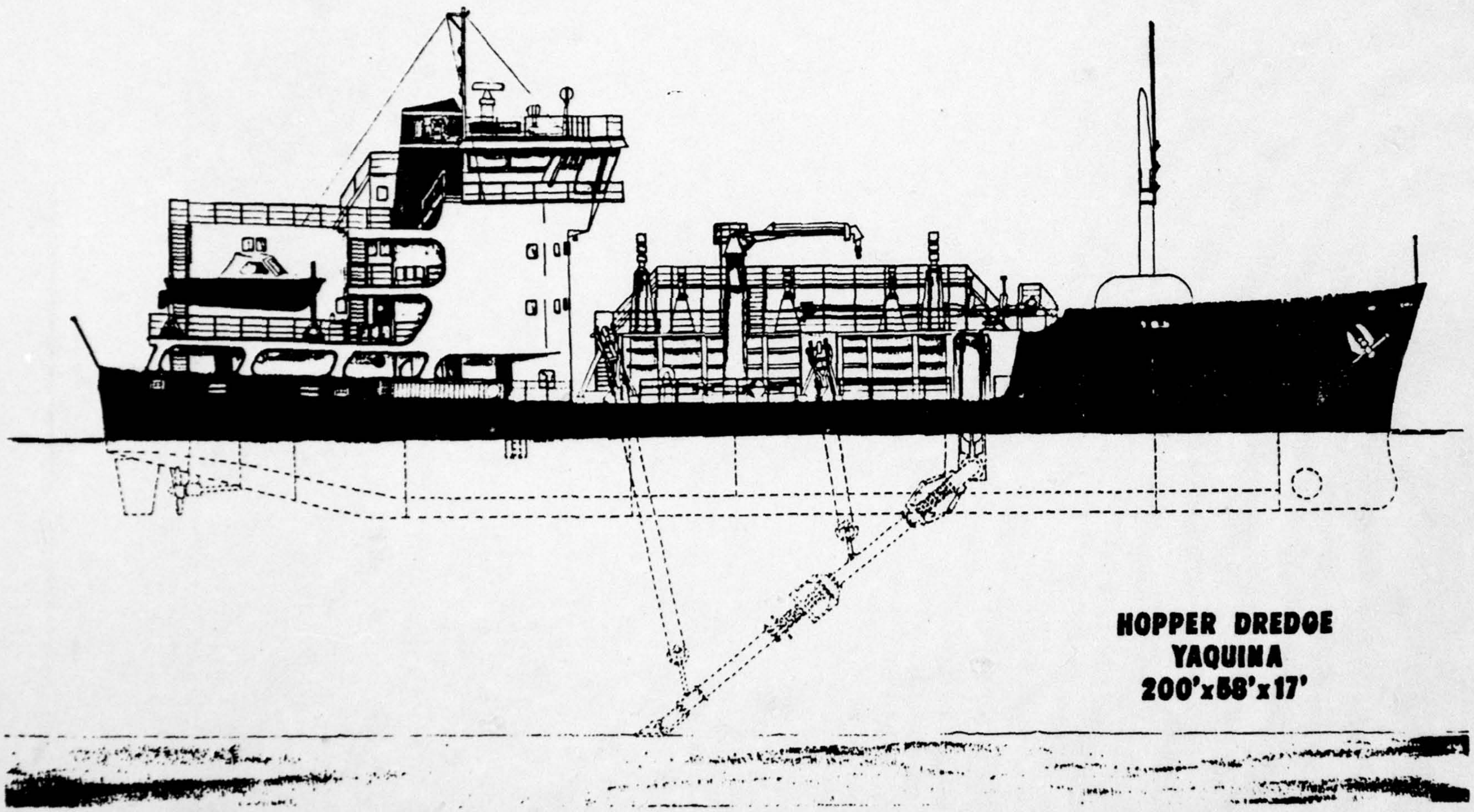
HOUSE REPORT No. 95-605 (Comm. on Public Works and Transportation).
SENATE REPORT No. 95-722 (Comm. on Environment and Public Works).
CONGRESSIONAL RECORD:
Vol. 123 (1977): Sept. 27, considered and passed House.
Vol. 124 (1978): Apr. 5, considered and passed Senate, amended.
Apr. 13, House agreed to Senate amendments.

BRIEFING ON THE HOPPER DREDGE REQUIREMENTS OF THE CORPS OF ENGINEERS

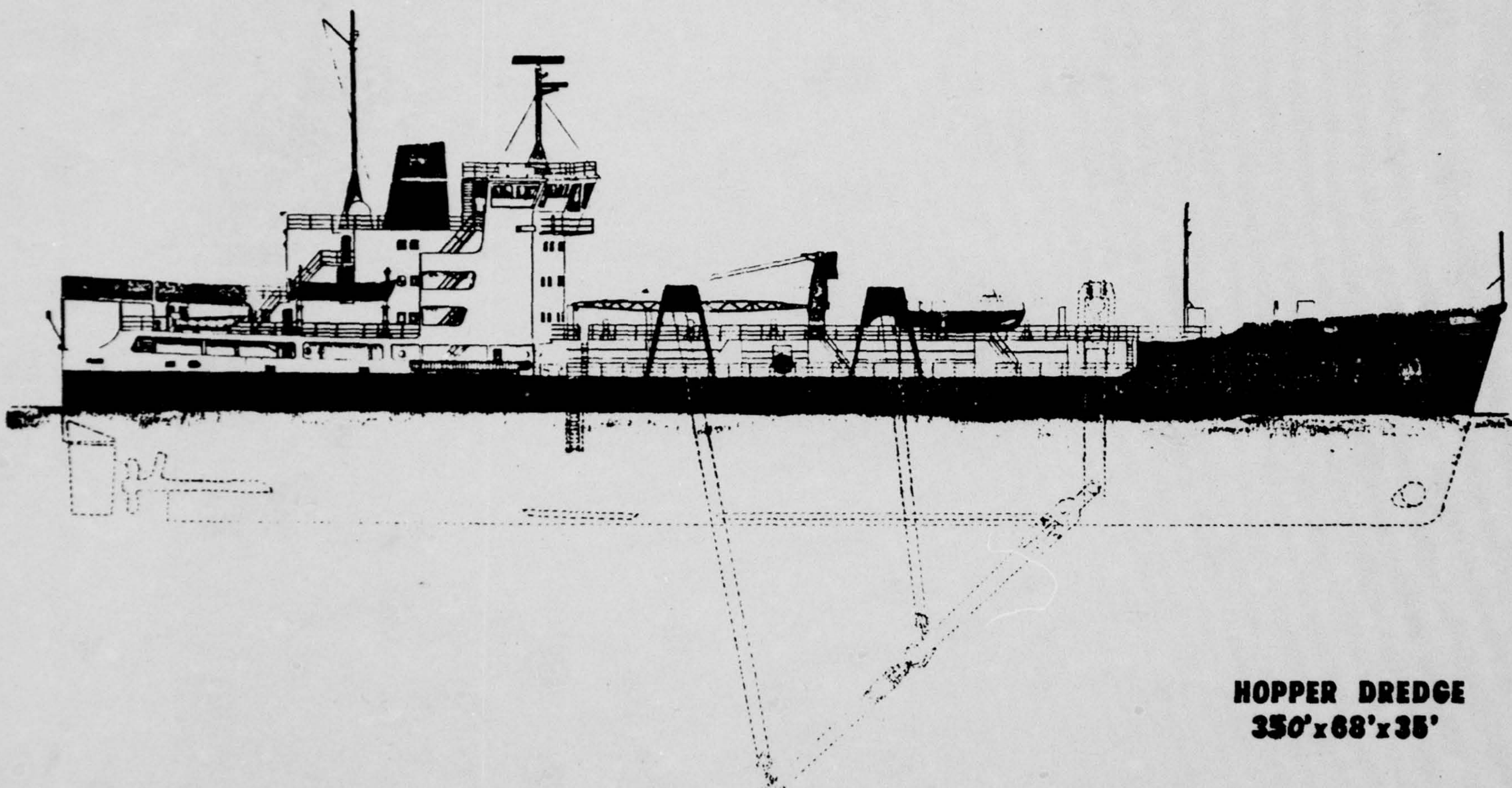
NEW HOPPER DREDGES

GENERAL CHARACTERISTICS

FEATURE	YAQUINA	MEDIUM CLASS	LARGE CLASS
LENGTH (FT)	200	350	409
BREADTH (FT)	58	68	78
HULL DEPTH (FT)	17	35	39
DRAFT-LOADED (FT)	12	27	29.5
DRAFT-LIGHT (FT)	8.7	16.75	17.75
HOPPER VOLUME (CU YDS)	825	6,000	8,400
SAND CAPACITY (CU YDS)	645	4,850	6,000
PROPULSION POWER (EACH) HP	(2)1,125	(2)3,600	(2)5,200
SPEED LOADED (KNOTS)	10.0	13.4	14.0
BOW THRUSTER POWER (HP)	243	600	800
DREDGING DEPTH (FT)	45	80	80
TOTAL NO. DRAGARMS	2	2	3
DREDGE PUMP POWER (HP)			
INBOARD	1,088	6,000	7,200
DRAGARM	-	2,800	3,200
STAFFING	28	38	40

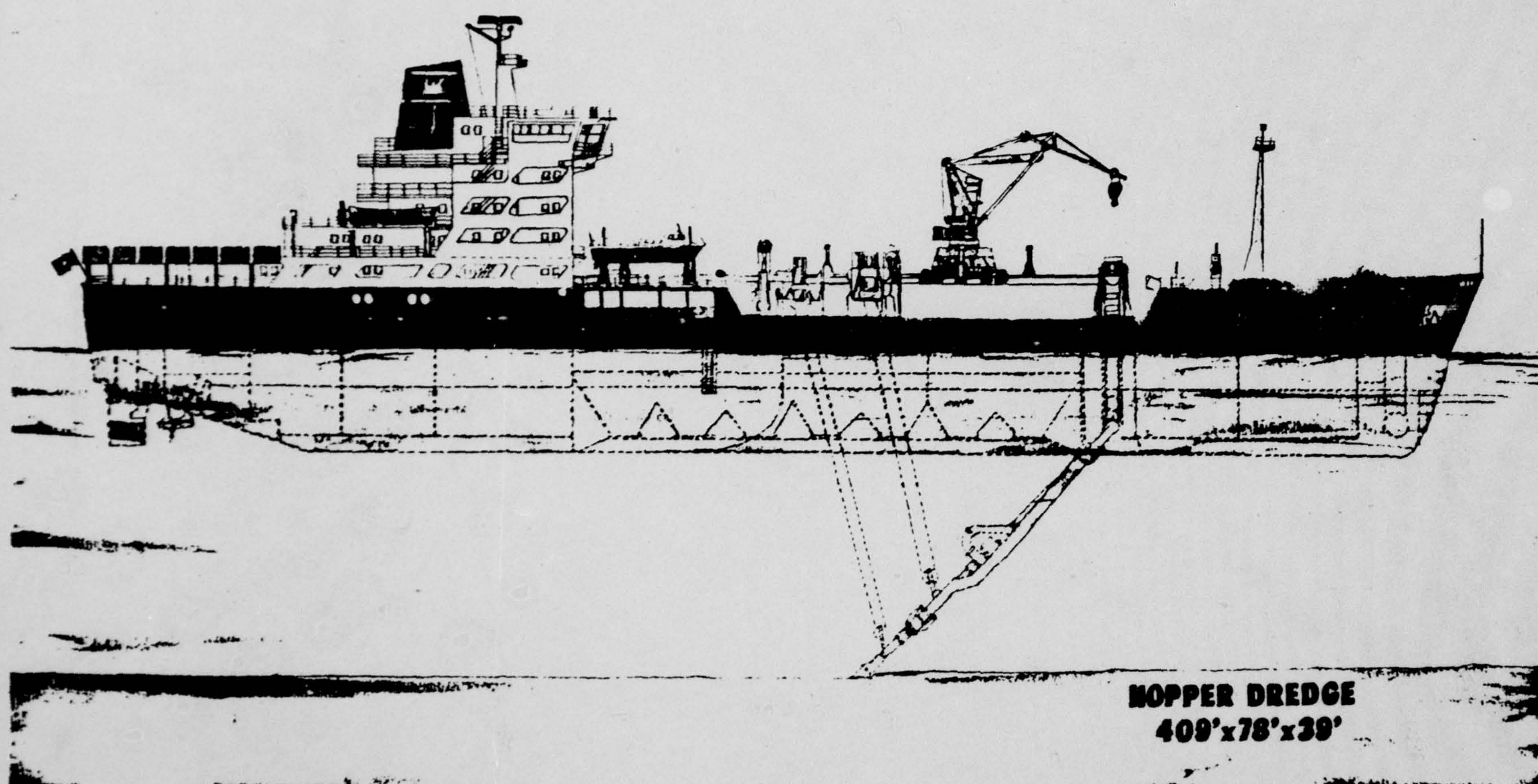


U.S. Army Corps of Engineers - Small class hopper dredge



HOPPER DREDGE
350'x68'x35'

U.S. Army Corps of Engineers - Medium class hopper dredge



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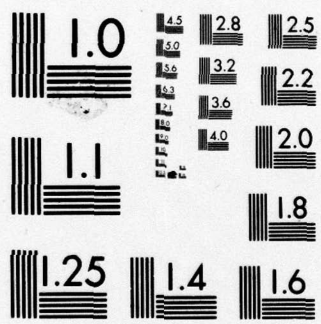

MICROCOPY RESOLUTION TEST CHART
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